ministry of

environment

Finlay-Omineca
Strategic Environmental Plan

BC MINISTRY OF ENVIRONMENT

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FINLAY-OMINECA
STRATEGIC ENVIRONMENTAL PLAN

PLAN SUMMARY

Planning and Assessment Branch
and
Northern Region
Ministry of Environment

Revised November, 1984

January, 1989

Canadian Cataloguing in Publication Data
Main entry under title:
Finlay-Omineca strategic environmental plan

ISBN 0-7726-0945-4

1. Environmental policy - British Columbia - Finlay River Region. 2. Environmental policy - British Columbia - Omineca River Region. I. British Columbia. Ministry of Environment. Planning and Assessment Branch. II. British Columbia. Ministry of Environment. Northern Region. III. Title: Omineca strategic environmental plan.

HC117.B7F56 1989 333.7'15'097111 C89-092111-3

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MINISTRY OF ENVIRONMENT

Northern Region Planning and Assessment Branch

November 1984

Since the analysis in this plan was completed in November 1984, some of the material is out of date as of early 1989. Due to the requirement of substantial additional funding before major fish and wildlife activities could be carried out, Ministry approval was delayed until a compensation Agreement for Williston Reservoir was reached with B.C. Hydro. The compensation agreement provides funding for fisheries and wildlife management activities, which are the Ministry's priorities in this area. The 3-year fish and wildlife management plans prepared jointly by B.C. Hydro and the Ministry are attached as appendices. Many of the less costly activities recommended throughout the plan have been undertaken since late 1984.

J. O'Riordan

J. O'Riordan
Director
Planning and Assessment Branch

January 11, 1989

Date

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FINLAY-OMINECA STRATEGIC PLAN

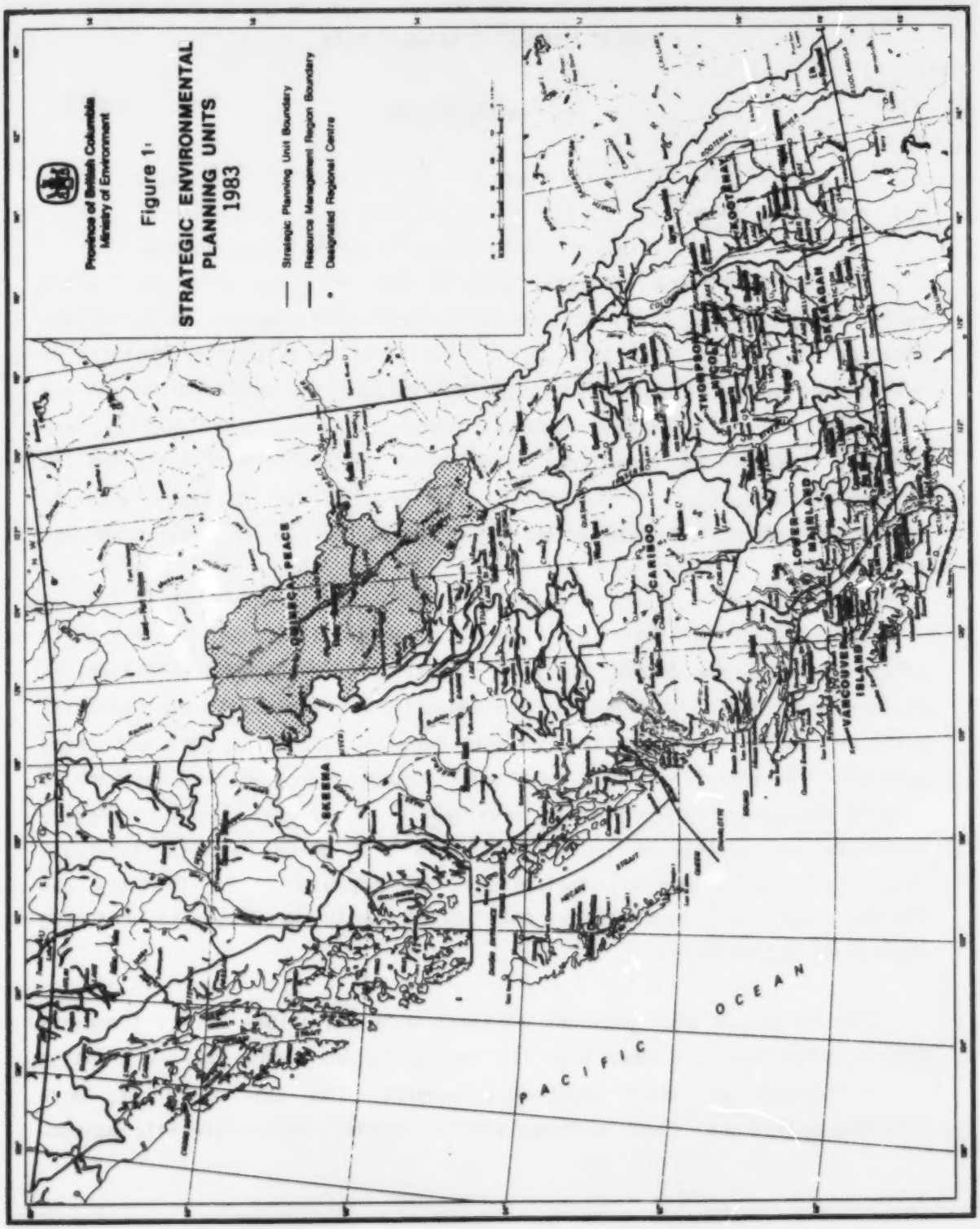
1. INTRODUCTION

1.1 PURPOSE OF PLAN

The Finlay-Omineca strategic plan is one of a number of such plans being prepared by the Ministry of Environment for various parts of the Province (Figure 1). The purpose of these plans is to provide Ministry of Environment managers with direction and guidance in the allocation and management of environmental resources (water supplies, water quality, air quality, fisheries and wildlife) and to assist the Ministry in achieving its management objectives. The plans also provide the Ministry with an organized information system which can be updated as new information becomes available.

Sub-regional strategic plans are being prepared because, in many parts of the Province, the demands for environmental resources may exceed supplies at current levels of management. Consequently, the Ministry's environmental goals and objectives, and environmental quality standards, are not being achieved. In addition, budget restraints require that a planned approach to setting management priorities be developed. Furthermore, it will provide inventory and evaluation should trade-offs with other resource interests such as forestry, mining, agriculture, be required. The Ministry can thereby negotiate appropriate compromises while meeting its resource objectives and mandate.

The strategic plan provides managers with a flexible policy framework within which they can make specific regulatory decisions such as granting water licences and waste management permits. In some instances, more detailed operational level analyses will be required before specific manage-


Province of British Columbia
Ministry of Environment
Figure 1:
STRATEGIC ENVIRONMENTAL
PLANNING UNITS
1983
Strategic Planning Unit Boundary
Resource Management Region Boundary
Designated Regional Centre
PACIFIC
OCEAN

ment measures can be implemented. Such measures should conform to the policies and objectives set out in the plan.

Although there is a fair amount of flexibility built into the planning process, there are some firmly-stated environmental objectives that establish boundaries beyond which the Ministry would be reluctant to compromise. These objectives may include defined minimum instream flows for fisheries, waste dilution and recreation, licensed allocations for consumptive and non-consumptive water diversions and uses, maintenance of wildlife species diversity, angling and hunting success rates and selected water quality objectives. If these objectives cannot be achieved or maintained over the next five years, then the plan should be formally reviewed and if appropriate, amended to change its objectives accordingly.

This summary is based upon a Technical Report and supporting appendices and reports which may be consulted for more detail.

1.2 THE MINISTRY OF ENVIRONMENT MANDATE

The Ministry of Environment has a legislative mandate to manage wildlife, fisheries, water, water quality and air quality in the Finlay-Omineca unit. Under the umbrella of the Environment Management Act, the Ministry is charged with developing policies for the management, protection and use of the environment, and for planning its use. The provision of information to the public with respect to the quality and use of the environment is also mandated under this Act.

In the case of wildlife, the Wildlife Act is the legislative base permitting the Ministry to manage harvest, movement and possession of wildlife to ensure an abundance and diversity of wildlife populations for the recreational enjoyment of British Columbians. However, the Ministry does not have jurisdiction over the land base which provides the habitat for all wildlife species. Consequently, when this plan sets management objectives for wildlife species, it provides information which can be used in

discussions with Ministries such as Forestry and Lands, Parks and Housing, which have jurisdiction over the land base.

The Ministry is also responsible for the management of resident sport fish in the Finlay-Omineca planning unit. As well as maintaining the supply of sport fish, the Ministry of Environment plays a vital role in safeguarding fisheries habitats through the maintenance of required instream flows, protection of water quality and the preservation of riparian vegetation and rearing habitats.

The Ministry of Environment has the responsibility for ensuring the environmental management of the water resource. The Water Act, administered by the Comptroller of Water Rights and the Regional Water Managers, is the basic legislation under which licences are issued and regulated for the diversion and use of surface water with due regard for identified instream uses such as fisheries, recreation and waste management, and for flood protection. Currently, the Water Act has not been proclaimed applicable for groundwater. The Ministry is also responsible for reducing flood damage by controlling, or otherwise providing input to, flood plain development initiatives.

The Ministry also has a mandate, under the Waste Management Act, to manage waste discharges such that the ambient quality of surface and ground waters is maintained at or above levels required for allocated water uses. Recently, the Ministry has initiated a program of studies that will establish ambient water quality criteria or levels for various instream and consumptive uses.

The maintenance of clean air is the other major responsibility of the Ministry, also under the Waste Management Act. As this is not a major concern in the Finlay-Omineca unit, it is discussed in less detail.

1.3 DESCRIPTION OF THE PLANNING UNIT

The Finlay-Omineca Strategic Planning Unit is the west-central unit of the five in the Omineca-Peace Region (Figure 2), occupying approximately

Figure 2 Omineca–Peace Region Planning Units

72,500 square kilometres, or about 22.4% of the Region. Within the Region, it is exceeded in size only by the Liard-Fort Nelson unit. However, until approximately two decades ago, this large area was very sparsely inhabited, and industrial development was limited to a minor amount of forestry in the extreme south of the unit. Transportation facilities were limited to a highway and rail line making use of the Crooked River valley in the south, and Pine Pass through the Rockies to the Peace River area (Figure 3). In total, the population was likely little different in size from that found by Mackenzie during his 1793 expedition up the Peace and Parsnip Rivers. As a result there was little competition for land and water use, and an abundance of environmental resources. Industrial development of the planning unit is still limited and of recent origin. The decision to utilize the large amounts of water runoff available from the Finlay and Parsnip Rivers for hydroelectric purposes in the 1960s was the starting point for changes which would lead to environmental shortages. The filling of the Rocky Mountain Trench by runoff from these major rivers and their tributaries had major impacts on fish and wildlife resources which are still continuing. With the establishment of a major forest industry processing center at Mackenzie in 1967 to utilize the timber resources of the numerous major river valleys in the unit, the other important river valley habitats began to be altered through logging, making them less suitable for wintering by moose. Increased access via forest roads has compounded the declining supply of moose by bringing increased demand. As forest and mining roads continue to be extended into the formerly remote parts of the unit, other wildlife species, and lake fisheries, have become increasingly affected by an excess demand on the accessible supplies.

The Finlay-Omineca is still very sparsely settled with Mackenzie (1981 population of 5800) the major population center. Most of the other permanent inhabitants of the planning unit live in the south between Mackenzie and Summit Lake in communities along Highway 97. The remote communities of Ingenika and Fort Ware in the north, as well as McLeod Lake in the south, are Indian settlements. The remaining permanent settlements are found along the Omineca and Manson Rivers at Manson Creek and Germansen Landing.

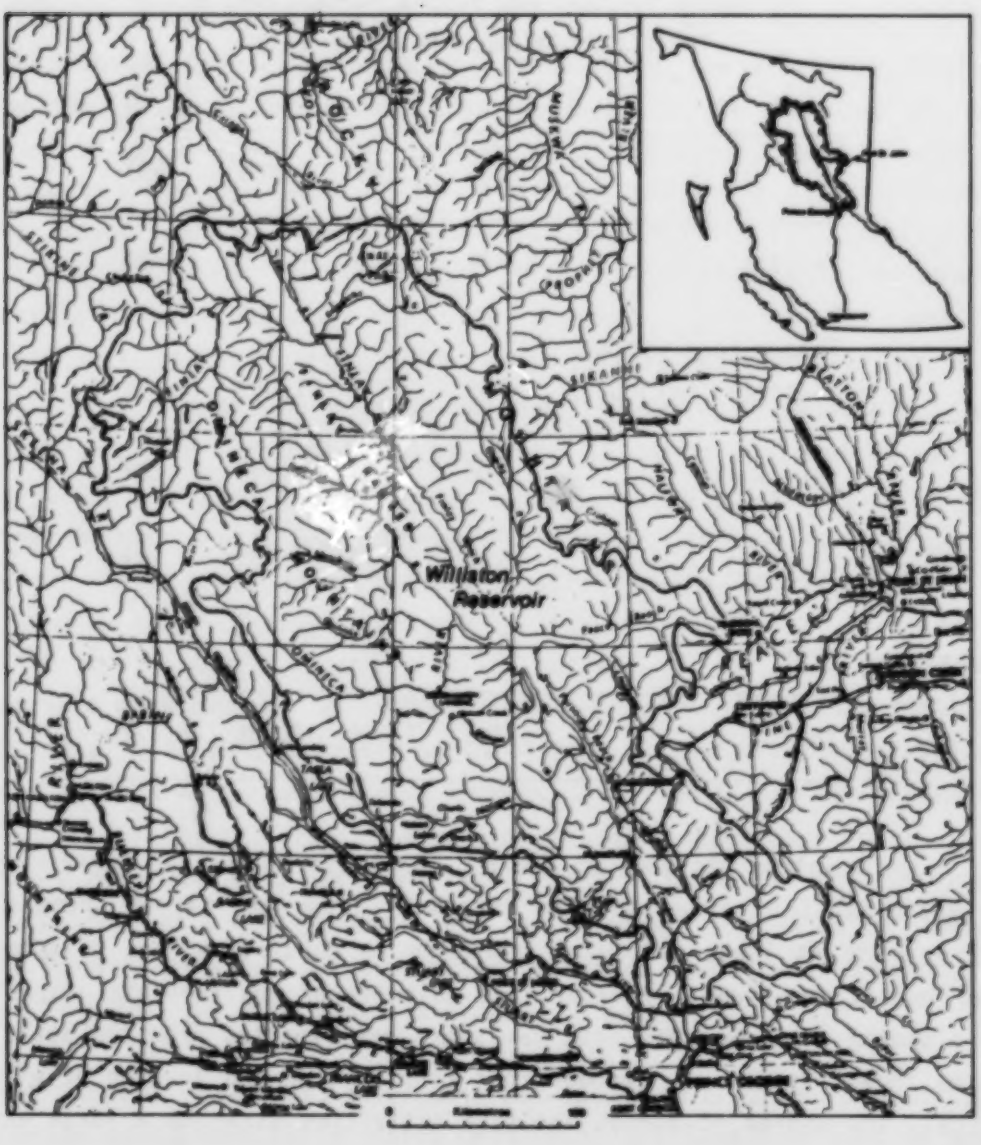


Figure 3 Finlay-Omineca Planning Unit

Table 1 summarizes recent population estimates for the planning unit and provides population forecasts based on extrapolation of past growth rates.

TABLE 1
ESTIMATED PRESENT AND FUTURE POPULATIONS OF
THE FINLAY-OMINECA PLANNING UNIT

	1976	1981	1986	1991
Mackenzie	5,338	5,803	6,309	6,858
Fraser-Fort George Electoral Area G	958	974	1,059	1,151
Fort Ware	166	175	190	207
Ingenika	128	139	151	164
Other	150	163	177	192
Total	6,740	7,254	7,886	8,572

Major developments such as the B.C. Rail line along the Table River to the Northeast Coal area, and the proposed Cirque and Carbon Creek mines, will lead to at least temporary increases in population, and to potential water quality problems. However, the majority of environmental impacts in the planning unit over the next few years are expected from the activities of the forest industry. Through road construction and logging of wildlife habitat, the degree of forest industry activities will, to a large extent, dictate the amount of demand for and supply of fish and wildlife resources. This stresses the need for adequate information to properly manage these resources.

1.4 MAJOR ISSUES OF CONCERN

From the Ministry of Environment viewpoint, the most important issues in this planning unit concern wildlife and fisheries. In the case of wildlife, the present shortage of supply of the most important big game species, moose, originated with the creation of the Williston Reservoir during the 1960s. The Bennett Dam resulted in the flooding of about 1500 km^2 of prime river-valley habitat which had constituted probably the best moose wintering range in the Province. With the reservoir came a forest industry which each year since has expanded its activities further away from its base in Mackenzie, with concomitant wildlife habitat alterations through extensive clearcuts, and access provision into areas not formerly available to hunting. The result is that moose populations in the vicinity of the reservoir are much reduced from their pre-reservoir levels, and combined with increased access, there is sufficient hunting pressure being put on big game species, especially moose, to require restriction of hunting in some areas. The inaccessibility of particularly the northern third of the unit has also resulted in very limited knowledge of all big game species. As forestry and mining activities open up new areas to wildlife users, the fish and wildlife manager is not in a position of appropriate knowledge for setting wildlife regulations. With the continuing provision of road access in all parts of the unit, populations of big game species other than moose are also thought to be declining, but information on them is so limited that an accurate assessment of trends in population sizes is not possible. Of additional concern is Native Indians use of wildlife, both as a food resource, and for trapping. The extent of this use is at present unknown, and management decisions taking all components of demand into consideration cannot therefore be made.

In terms of fisheries, there does not appear to be a shortage of supply on average throughout the planning unit, but localized shortages do occur, especially in areas of new access. In addition, problems similar to those

for wildlife exist. The reservoir not only flooded large areas of river valley, but also changed extensive lengths of the Parsnip, Finlay and Peace Rivers from a river to reservoir environment. Over a period of less than 2 years, the habitat of river-adapted species, such as rainbow trout and Arctic grayling, changed to an enormous reservoir system which fluctuated widely in depth during the year. This resulted in degraded and reduced spawning areas, and an extensive shore zone which is essentially abiotic due to water level changes. Although a fisheries survey of the Reservoir took place during 1974-75, it is known that fish species composition, abundance and distribution change as a reservoir ages. Current information is vital to fisheries management, necessitating a survey update. In addition, access particularly by boat to stream mouths, has led to overfishing in these critical areas, and the imposition of closures. In parallel with wildlife issues, the continuing provision of access into more remote areas of the unit brings anglers. Inventory of many of these newly available lakes is lacking, making mangement decisions difficult. Finally, the majority of angler pressure occurs in those accessible lakes near centres of population. This necessitates a stocking plan if this demand is to be met.

Water supply in this planning unit greatly exceeds licensed use. In general tnere is adequate hydrometric gauging of major streams, but inadequate data for smaller streams. However, regionalization of available information would aid the Water Manager in estimating peak flows of streams which must be crossed using bridges or culverts as new roads are built. In addition, tne gauges on major streams, originally located for reservoir level management purposes, do not provide data applicable to smaller streams.

There are presently no problems with water quality in this large unit. Problems are mostly site-specific, rather than involving the cumulative effects of a number of effluent discharges within a single sub-basin. Examples include Dupont's Baker Mine, where effluent discharges have contained high levels of cyanide. Damage to fish habitat has occurred in the Table River as a result of poor sediment control during tunnel and rail

construction by B.C. Railway. Cyprus Anvil's proposed Cirque Mine should be assessed for possible water quality problems, as should Utah Mine's Carbon Creek coal proposal. In the Mackenzie area, two pulp mills and the village sewage treatment system discharge to Williston Reservoir. Concern about water quality also exists in large areas of the western part of the unit, where naturally elevated mercury levels are present, and where placer mining and logging activities may increase mercury levels in water systems.

Although not a water quality problem in the usual sense, the floating and standing wood debris on Williston Reservoir, resulting from creation of the reservoir in the late 1960s, constitutes a problem of major proportions for navigation. Commercially, the floating debris plug has blocked water access up the Finlay River, causing problems for the Ingenika and Fort Ware Indian villages, and for exploration projects. Floating and standing debris is also a hazard for recreational use of the reservoir.

The only major refuse disposal site and problem area concerns the Mackenzie refuse site. Although it is generally well operated, it is a major concern due to the resident grizzly bear population. The only solution to this is the operation of incineration facilities.

There is one special waste storage area in the unit. In the early 1980s, B.C. Hydro was storing 15,000 PCB capacitors on the ground at the Kennedy sub-station. In the past, some of the containers have leaked, requiring a major clean up.

Air quality concerns are mainly limited to the Mackenzie area. The Kraft pulp mill odor is a public nuisance, although the mill is generally complying with the conditions of its air emissions permit. Occasional smoke emissions associated with seasonal slash burning, the non-compliance operation of beehive burners, and yard clean-up of waste wood at sawmills in Mackenzie contribute to air quality problems. A general assessment of air

dispersion potential in the Mackenzie area is required to provide the Waste Manager with a preview of possible air quality problems should there be future industrial expansion in the area.

1.5 PARTICIPATION IN THE PLAN

This plan has been prepared by a working group consisting of the following Headquarters and Regional Staff:

Headquarters

Planning and Assessment Branch (Jon O'Riordan)	Brian Turner (Plan Coordinator), Cathy Meagher, Roger Reid, Bob Williams.
Water Management Branch	Ben Kangasniemi, Bob Truelson, Brian Retzer, Bill Obedkoff, Geoff Travers, Dennis Sinnott, Kevin Ronneseth
Waste Management Branch	Richard Bennett, Rod Davis
Surveys and Resource Mapping Branch	Terje Vold, Spencer Sutton, Gord Enquist

Region (Ben Mitchell[1], Regional Director)

Fish and Wildlife (Steve Willett)[2]	Dennis Ableson, Ken Child, Dave King
Water Management (Dennis Roberts)	Dennis Roberts
Waste Management (Ron Driedger)	Rich Girard, Harry Vogt

Within the Ministry of Environment, other individuals contributing advice, information or services were: Bill Arthur, Cliff Bancroft, Dan Blower, Jim Brown, Greg Cheeseman, Joan Chess, Paul Haley, Patti Jones, Don Morberg, Yvonne Olsen, Roland Rocchini, Susan Schwab, Ron Thiel, Bruce Thompson, Leah Waddington.

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[1] Now Earl Warnock
[2] Now Dave Zirul

2. WILDLIFE

2.1 WILDLIFE PROGRAM OBJECTIVES

Provincial wildlife management goals are:

1. to maintain the diversity and viability of species representative of the major biophysical zones of the province; and
2. to ensure that, within the constraints of land capability and the biological limits of each species, wildlife is available in sufficient abundance to meet the social, recreational, ecological, and economic needs of society.

In the Finlay-Omineca unit, the anatum subspecies of the peregrine falcon is the only species which may be threatened in terms of its viability. However, no information is available in this area regarding its current status.

The second objective is of direct concern in this unit, since land capability for producing wildlife is becoming constrained in some areas. There are indications that several big-game species are no longer sufficiently abundant to meet the recreational demand, as a result of both reduced supply and increased demand. For example, although the 1980 planning unit success rate for moose averaged 28 days per kill (Table 2), the rates were up to 40 days in the more accessible southern parts of the unit, and this is an unacceptable success rate. A success rate this low supports a regional assessment that the supply of moose, for example, is considerably reduced from former levels, and has led to various regulations to curtail hunting. By comparison, the Omineca-Peace regional average for 1980 was under 23 days. Harvest objectives for the planning unit cannot be specified, since their calculation is dependent upon knowledge of population sizes, and the application of a nominal 30 percent harvest rate. A similar situation exists for the other big-game species in the unit, and a conservative management approach taking into account trends in harvest, success rates, and scattered population estimates (mainly for the alpine species)

has led to an increasing use of hunting closures, quota systems, limited entry hunts and other restrictive regulations.

2.2 SUPPLY/DEMAND ANALYSIS

Appropriate management of the wildlife resource requires knowledge of the present and potential supply of the various priority species, and the present and projected demand for them. Present supply knowledge is insufficient for this detailed analysis to be possible, but consumptive wildlife use information is generally much more complete. The major uses which must be determined for demand analysis include consumptive uses such as hunting, commercial (trapping and guiding), and native sustenance, and to a lesser extent non-consumptive use. The priority species for Finlay-Omineca, based on hunting demand are:

Priority	Species/Grouping
1	Moose
2	Caribou, thinhorn sheep, mountain goat
3	Grizzly bear
4	Elk
5	Furbearers
6	Deer

HUNTING ACTIVITY

Big-game hunting is the major use of wildlife in this area, and is therefore the primary management concern. It tends to be concentrated in the southern part of the unit, south of the Peace Arm, and west of Williston Reservoir. Moose is the most heavily hunted big-game species, with an estimated 68% of the total reported 1980 resident hunter days in the planning unit spent on this species (Table 2). Next in terms of hunter days was black bear, with 12% of the activity. The other big game species hunted in the planning unit in order of the amount of hunting effort devoted to them were: deer, grizzly bear, caribou, goat, sheep and elk. As might be expected the harvest of animals was heaviest in the areas most intensively

TABLE 2

SUMMARY OF RESIDENT HUNTING ACTIVITY IN FINLAY-OMINECA UNIT, 1980

SPECIES	HARVEST[1]	HUNTER-DAYS	SUCCESS RATE[2]		
			Finlay-Omineca	Omineca-Peace	Province
Moose	550(168)	15,334	27.9	22.6	28.1
Black Bear	220 (40)	2,645	12.0	11.1	13.8
Deer	51 (1)	2,299	45.1	53.1	22.0
Grizzly Bear	12 (27)	895	74.6	40.1	47.4
Caribou	24 (9)	682	28.4	33.1	32.6
Mountain Goat	39 (62)	479	12.3	19.4	13.0
Thinhorn Sheep	2 (16)	234	117.0	30.2	47.2
Elk	0 (17)	96	--	23.7	48.8
TOTAL		22,664			

1 Additional harvest by 348 non-resident hunters given in parentheses.

2 Defined as hunter days per kill.

hunted. There was an estimated 550 moose and 220 black bear harvested in the planning unit by resident hunters during 1980. The number of animals harvested of any of the remaining species is quite small in comparison.

Hunting effort during the period 1976-80 showed a fairly consistent and sharp decrease in the number of days spent hunting caribou. There was a noticeable increase in bear hunting effort in 1980 compared to earlier years. For other species, effort devoted to hunting (i.e., the total hunter days) in the planning unit remained relatively stable over this period. The harvest of caribou declined from 1976 to 1979, but recovered somewhat in 1980. There was also an exceptionally large harvest of black bear in 1980.

A high proportion of the resident big game hunting effort in the planning unit was by hunters living in the planning unit and the Prince George area and to a lesser extent in the Peace River Planning Unit (64% in all). Hunters from the Lower Mainland and Vancouver Island Regions contributed about 19% and 9%, respectively, of the total resident hunter days in the planning unit.

The number of guided non-residents hunting in the planning unit has generally been quite stable since 1971. The estimated number of hunter days by non-residents was about 15% of the number of resident hunter days in 1980, and about 14% in 1979. Non-resident hunters also appear to regard moose as the most important species hunted. In recent years, the non-resident harvest of moose was followed in magnitude by: goat, black bear, grizzly bear, elk and sheep in approximately that order. Non-resident hunters harvest greater numbers of goat, sheep, elk and usually caribou than do resident hunters. However, their caribou harvest has displayed the same decline as noted earlier for resident hunters. Non-resident hunters also have a much stronger preference for grizzly bear than black bear compared to resident hunters.

It is unlikely that the amount of big game hunting effort in the Finlay-Omineca Planning Unit in the next five or ten years will differ

significantly from the present amount of activity. This activity remained relatively stable during 1976-1980, which may have been the result of hunting effort being shifted to other planning units, or more restrictive hunting regulations managing the amount of hunting activity within this unit. It is expected that current levels of activity will continue in the near future, given forecasts of relatively stable population growth and despite increasing costs of hunting. Finally, it is difficult to foresee an increase in non-resident hunting activity because of quotas on guides, and due to the increasing costs faced by non-resident hunters.

OTHER WILDLIFE USES

Trapping of furbearers is a significant activity in the planning unit with the 93 registered traplines generating estimated gross revenues of almost $170,000 during 1980. Marten was by far the most important species trapped during 1980, followed by beaver, lynx and mink. The trapping industry is quite cyclical, being dependent upon animal populations and the dictates of the fashion industry.

Although there are no accurate estimates of their activities, Natives are thought to place very heavy pressure on wildlife in the areas near their settlements. However, because of uncertainties regarding the applicability of Treaty 8, they may not be subject to hunting regulations. It is likely that moose is the preferred species for Native subsistence hunting during summer, with sheep, goats, caribou, elk and marmots being taken in the fall, but opportunity probably dictates as much as any single factor which species is killed. Furbearers trapped during the winter are also used for meat. It is probable that Native use of wildlife in the planning unit will continue at its existing unregulated level until treaty questions are resolved.

There appears to be a very small amount of effort devoted to hunting upland game birds, waterfowl and small game in the planning unit, and what does occur tends to be incidental to big-game hunting. The populations of many of these species are cyclical and the Fish and Wildlife Branch makes

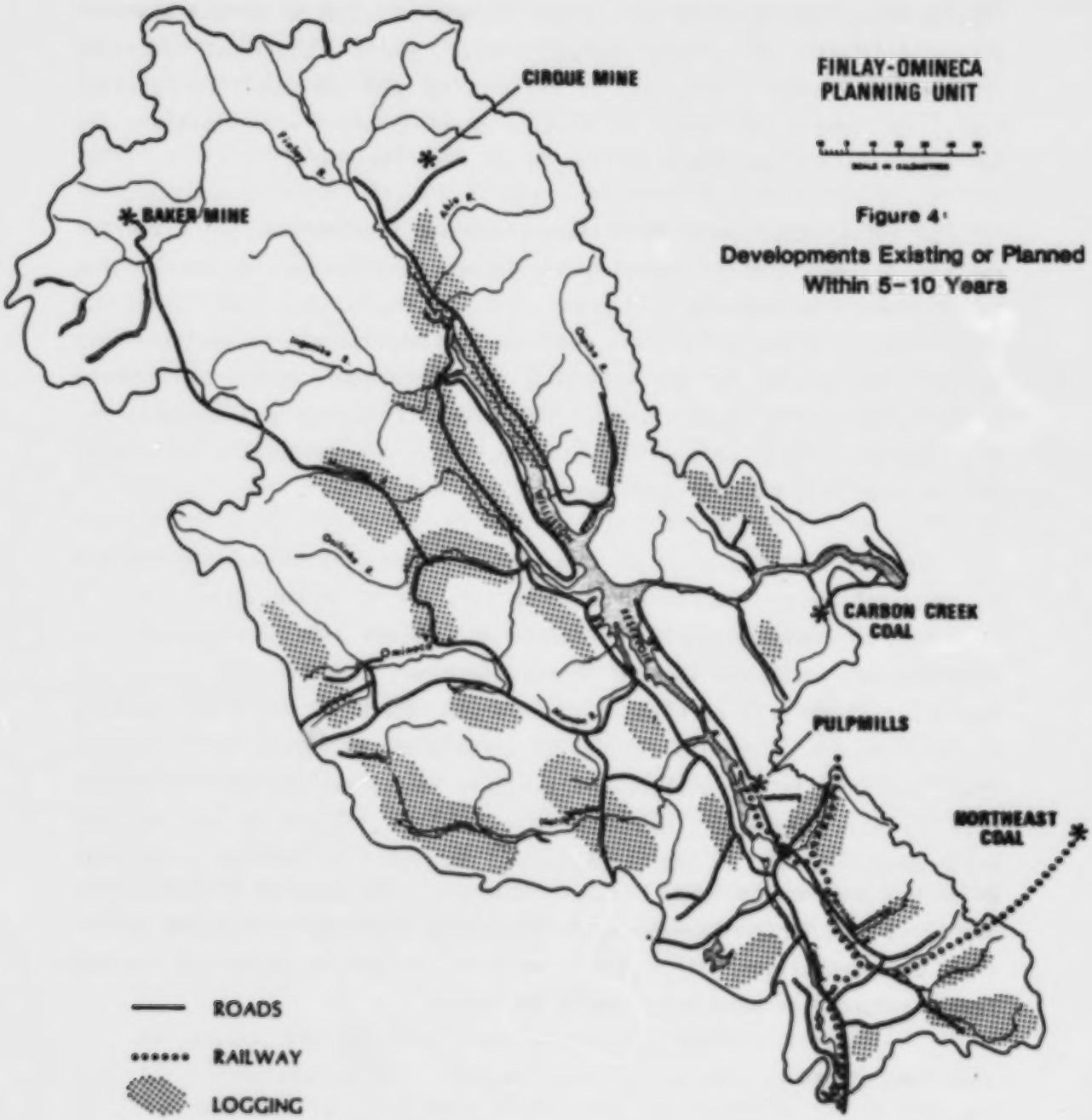
little effort to manage them, confining its activities to regulating seasons and setting bag limits.

A limited amount of non-consumptive wildlife activity occurs in the planning unit. It is probable that much of this activity is of an incidental nature, such as viewing wildlife along the highway, or from boats. This type of activity could be encouraged by identifying salt licks and other areas where ungulates congregate.

HUNTING MANAGEMENT

The change in moose hunting regulations over the past two decades illustrates how regulations have become more restrictive as the supply of moose has declined. Prior to Williston Reservoir, the moose season was long, and most of the pressure was on bulls. During the flooding stage of the reservoir, a bag limit of two moose was set, since the loss of winter range would have removed an estimated 12,500 moose in any case. As access to the planning unit was developed by logging and mining companies, both local and non-local demand for moose increased, requiring an adjustment in regulations to meet the increased demand. This has included limited entry hunting, and changes in regulations to harvest the non-breeding segment of the population (calves and yearlings), thereby limiting the number of prime breeders taken. The objective is to protect the main breeding segment of the population which, coupled with any habitat enhancement that is possible, will result in increasing moose populations. In addition to these regulations applied to resident hunters, non-resident hunters are now limited by a quota.

A similar trend to more restrictive regulations has occurred for other species. As of late 1984, Tatlatui Provincial Park and areas to the north of it were closed to sheep hunting, along with an extensive area north of Peace Arm. Limited entry hunting and non-resident quotas are in effect for sheep in some areas (e.g., Russell Range), and further restrictions will be required as access to formerly remote areas is developed. Limited entry areas and closures are also in effect for caribou, and restrictions in Management Unit 7-41 are possible for the near future. Potential closures



FINLAY-OMINECA PLANNING UNIT

Figure 4

Developments Existing or Planned Within 5-10 Years

near settlements are also likely for mountain goats in the near future, with limited entry, non-resident quotas, and harvest directed to the old segments of tne population being other possibilities. Use of rotational watershed closures is another likely way of restricting goat harvest. For grizzly bears, the length and timing of hunting seasons, along with limited entry and quota hunting, may limit harvest in the next few years.

In total, the former more liberal hunting regulations, which exerted harvest control through managing the length and timing of the hunting season, have been replaced by increasingly more restrictive regulations such as closures, limited entry areas, and non-resident quotas. This takes into account the greater demand resulting from increased access to formerly remote areas, and a lesser supply. The trend is thus to a continually increasing curtailment of hunting activity. All indications are that there will be even less hunting opportunity in the future.

The more northern areas of this unit are gradually becoming accessible to "outside" hunters (as compared to Natives living in tne area). This is occurring as resource-extraction industries proceed with developments (see Figure 4 for roads and logging areas). However, inventory of tne various species is even less well known than further south in the unit. Hunting closures have been applied to some of these areas as access is provided to them, and also in the vicinity of the more remote developments accessible only by air. However, enforcement capability limited by no resident enforcement manpower in the planning unit is unable to provide an adequate enforcing presence in these distant locations. The problem of maintaining supply is thus further compounded in that prime breeding animals are removed from the populations, since they cannot be adequately protected, harvest levels enforced or population levels monitored.

CONCLUSIONS

Although there is considerable consumptive use of wildlife in the planning unit, accurate population inventory is lacking for every big-game species. The subjective impression is that supply in at least the accessible areas of the planning unit is unable to meet the demand at

satisfactory success rates. This is particularly true for moose, which have apparently been in decline since Williston Reservoir inundated some of the best moose wintering range in the province, in the Parsnip Valley. The relatively stable resident hunting success rate for moose in the 1976-80 period is thought to be due to a shifting focus of hunting activity to more remote areas over time, but the actual supply of moose in areas both newly and previously hunted is not known. Appropriate management of hunting activity is therefore not possible. In total, the outstanding need for wildlife in this planning unit is for inventory of all big-game populations. A similar situation exists for furbearers, in that population levels are unknown, and manpower limitations permit little management of furbearers beyond maintaining traditional trapping seasons as established by legislation. Without considerably better knowledge of population numbers, management prescriptions cannot be designed for either big-game or furbearers. The manager's only option under these conditions is to set regulations as conservatively as possible, in order to protect the remaining population.

Particularly for moose, the big-game species historically the most numerous and most widely sought in the planning unit, enhancement programs must be identified to reverse the trend to decline of the species. Although several areas have been tentatively identified as potentially suitable for habitat enhancement, detailed feasibility investigations (e.g., current habitat conditions, and potential for enhancement), and species inventory are required before any firm management decisions can be taken. In addition, cooperation from the forest industry is needed to maintain critical mature forest in these areas during the beneficial period following enhancement.

In summary, the following requirements have been identified:

1. inventory of all big-game species in all parts of the unit, particularly accessible areas, and the northern 40% of the unit which has never been mapped for big game
2. identification of suitable habitat enhancement sites, especially for moose

3. knowledge of the extent of native use of big-game species and furbearers
4. greater enforcement capability for this large planning unit
5. identification of future changes in use, and resource allocation policies which address these changes.

2.3 MANAGEMENT OBJECTIVES

Ideally, the consumptive use of various wildlife species should be compared to the harvestable surplus of each species. From this comparison, it could be concluded whether greater or lesser consumptive use of a given species should be permitted, and whether additional management programs are required to either curtail the harvest and/or increase the supply through enhancement. Due to the lack of supply knowledge for any hunted species in the Finlay-Omineca planning unit, this level of analysis is not possible. Setting quantified management objectives is therefore not possible, and decisions must be made on the basis of intuition about population levels. The present impression is that demand for consumptive use of big-game species in this unit is greater than the supply available. The only reasonable management objective, therefore, is to manage for no decrease in population sizes from those now thought to be present. To achieve such an objective requires conservative management approaches including the setting of restrictive hunting regulations, and an emphasis on habitat protection. The need for population inventory of all hunted species in the planning unit is also emphasized. In the absence of inventory work, the trend to more restrictive regulations can be expected to continue, if the wildlife manager is to achieve a management objective of no further decline in population sizes of big-game species.

2.4 MANAGEMENT OPTIONS

Management options for the Finlay-Omineca wildlife program are based on the legislative requirement for the continued provision of wildlife administration. This includes the setting of hunting regulations (seasons,

limits, closures, quotas etc.) and administration of trapping and guided hunting. This is the single most important function which must be met for the unit.

Beyond this basic legislative requirement, the next most important priority pertains to the need for up-to-date inventory, particularly for moose in the vicinity of the reservoir. A clause in the 1962 Water Licence permits the Comptroller of Water Rights to request remedial measures from the reservoir developer to offset both wildlife and fishery losses.[1] Although some financial assistance was received in the mid-1970's, this has not been sufficient given the magnitude of the losses. For example, the sustained harvestable surplus of the moose population lost as a result of the reservoir is estimated to be approximately equivalent to the total planning unit harvest of moose in recent years. The costs imposed on the Ministry of Environment to assess and manage the present situation greatly exceed what would have been required in the absence of the reservoir. To this end, the regional wildlife biologist has proposed animal census and biophysical studies to assess the current situation in that part of the Finlay-Omineca unit. Successful completion of these studies would lead to identification of possible enhancement areas, and implementation of enhancement projects where cost-effective. These projects would be designed to increase moose populations in the unit, concentrating on high capability habitats to replace losses due to the reservoir. It is clear that without additional funding, it will not be possible to carry out the inventory and enhancement work which is required to counter the trend in decline of moose, and to increasingly restrictive moose hunting regulations. Inventory of other big-game species in the area of influence of the reservoir is also required.

As part of this inventory program, biophysical mapping is proposed for much of the planning unit, concentrating on the little known northerly portions of the unit (see Figure 5). Particularly as the northern area is opened up over the next few years through resource-extraction developments (see Figure 4), knowledge of habitat capability will be increasingly

[1] Appendix 1 contains the wildlife management program which forms part of the compensation agreement signed with B.C. Hydro.

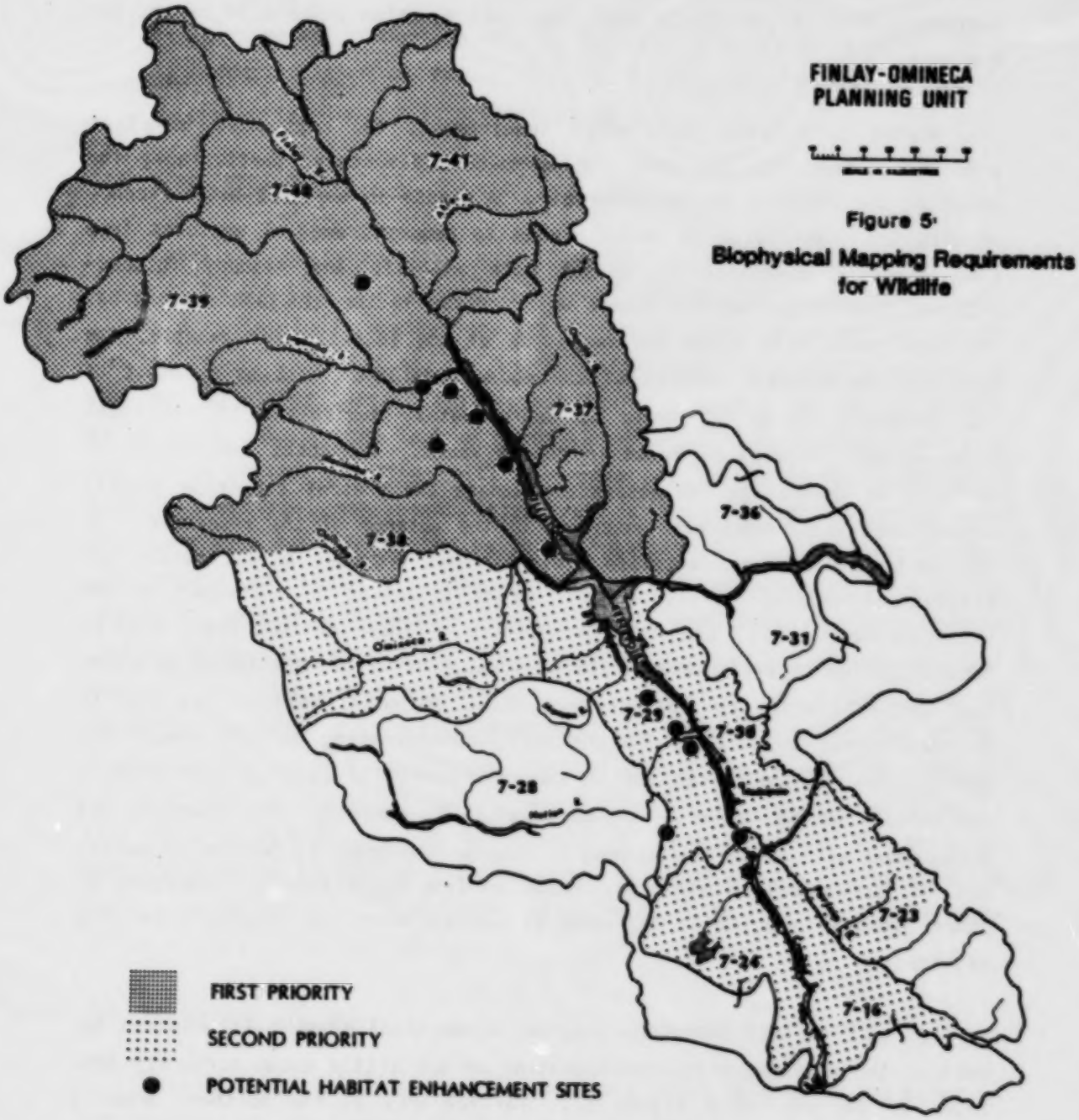


Figure 5.

Biophysical Mapping Requirements for Wildlife

important, since demand for big-game species in the area is certain to increase. Inventory of all species in these northern areas is also required in order to set appropriate wildlife harvest quotas.

In summary, there are three options available for big game species in this planning unit, all of them based on the assumption that the supply of the priority species (moose, caribou, thinhorn sheep, mountain goats) is, at least in some part of the area, unable to meet the consumptive demand:

1. Inventory - to provide the basic information on which to make sound management decisions.
2. Curtail hunting demand - through increasingly restrictive hunting regulations including limited entry hunting, closures, quotas, etc.
3. Increase the supply - through identification and manipulation of suitable enhancement sites. This appears to be particularly feasible for moose, much less so for the other species, and essentially not possible for caribou and mountain goats.

The desirable course to follow includes all three options, with conservative regulations designed to result in no further population declines in the interim, while the other two options are being pursued. In the absence of supply numbers, hunting regulations are set according to previous levels for each Management Unit, while monitoring harvest and success rates for each species. A drop in harvest or a trend to more days required to make a kill provides the cue that the population in question has been overhunted, albeit after the fact. A more accurate knowledge of supply will be achieved through inventory studies, and the desirability and specifics of habitat enhancement to increase supply will be generated through the biophysical program. Should funds and staff not be available for either inventory or enhancement work, the only viable option will be the continued imposition of increasingly restrictive hunting regulations.

2.5 MANAGEMENT PLAN (Table 3)[1]

To move towards replacement of those big game populations lost as a result of the Reservoir, a two-part study will be initiated as soon as possible, with the following components. Both of these programs are contingent upon allocation of funds in excess of those currently available for regional wildlife activities.

1. Biophysical mapping (see Figure 5).
   First priority areas include M.U.s 7-37, north 7-38, 7-39, 7-40 and 7-41. This mapping involves approximately three 1:250,000 map sheets (about 38,000 km^2 in total), and requires a 2-year period, costing approximately $160,000 per year.

TABLE 3

PROPOSED WILDLIFE MANAGEMENT ACTIVITIES IN FINLAY-OMINECA UNIT

Activity	Location
Biophysical Mapping	1st priority: M.U.s 7-37, north 7-38, 7-39, 7-40 and 7-41. 2nd priority: south 7-38, 7-29, 7-30, north 7-16, north 7-23, north 7-24.
Population Inventory	To proceed with mapping of areas above.
Habitat Enhancement	Phillip Creek - moose Lignite Creek - moose Pack River - moose Dastaiga Creek - Nation Arm - moose Blackwater Swamp - moose Carina Lake (Mesilinka River) - moose Ingenika River - elk Flood Creek - moose Factor Ross Creek - moose Ole Creek - moose Russell Range - sheep Chunamon Creek - Bob Fry Creek - moose

[1] Consult Appendix 1 for details of the wildlife program agreed to with B.C. Hydro.

Second priority areas include south 7-38, 7-29, 7-30, north 7-16, north 7-23 and north 7-24. This area covers approximately 20,000 km^2 (about 1.5 map sheets as above), and is estimated to require 2 years to complete, at $46,000 per year.

2. Population inventory.

This activity is designed to complement the mapping program, and utilizes stratified sampling of representative habitat types to enumerate ungulates, furbearers and carnivores. This 5-year program will result in population inventories in sufficient detail to be suitable for more appropriate management of the planning unit's wildlife.

3. Habitat enhancement.

Even in the absence of reliable supply/demand data, a number of sites in the planning unit have been tentatively identified as having good potential for habitat enhancement activities (see Figure 5). During the next 1-2 years, these sites will be assessed in detail for their suitability, and enhancement activities subsequently undertaken as possible. The recommended source of funds is the Habitat Conservation Fund.

In addition, enhancement sites will be identified through the mapping and inventory programs outlined above, but their locations, management costs, and source of funds cannot be detailed until several years of mapping and inventory have occurred.

3. FISHERIES

3.1 FISHERIES PROGRAM OBJECTIVES

The fisheries management goal as of 1984 is to produce maximum economic, cultural, recreational and scientific benefits for present and future generations of British Columbia by:

1. maintaining all native and desirable introduced species of fish at optimum levels of distribution, abundance and health, and protecting or enhancing essential freshwater habitat;
2. providing an equitable distribution of opportunities for a wide variety of socially acceptable uses of fish by all segments of society.

For the Finlay-Omineca planning unit, the key terms in the first objective are distribution and abundance. There is a major concern that both distribution and abundance of fish have undergone considerable changes in Williston Reservoir since an extensive survey nearly a decade ago. This has resulted in difficulties in setting regulations, and assessing enhancement possibilities, or the potential for a commercial fishery. In other parts of the unit, notably tne small lakes, the low productivity rates and bursts of angling demand as "new" lakes become accessible by road, has led to a "boom and bust" type of fishery. Therefore, for these lakes, and tnose not yet accessible, the same variables of distribution and abundance are of importance. Finally, the abundance of sport fish in those easily accessible lakes near population centres is a management concern, as they consistently experience the heaviest angling pressure.

The second fisheries program objective has its greatest relevance in this planning unit with respect to the Native Indian sustenance fishery. This important component of fisheries use is unregulated due to uncertainties regarding the applicability of Treaty 8, and the unquantified degree of use results in difficulty in setting appropriate angling regulations.

3.2 SUPPLY/DEMAND ANALYSIS

An adequate assessment of the status of the planning unit's fisheries to meet the fisheries management goal requires knowledge of present and potential fish supply, and present and projected angling use. Priority sport fish species in the unit are (in order) rainbow trout, Arctic grayling, Dolly Varden char, lake trout (char), and mountain whitefish. Also of considerable value but not generally classed as a sport species is lake whitefish, a potentially commercial species which inhabits Williston Reservoir, and is common throughout the planning unit. In addition, burbot is becoming increasingly sought by anglers through a set-line fishery. At present kokanee are of limited distribution, but are suspected to be increasing in Williston Reservoir. Regional fisheries staff recognize the angler appeal of this species, and are investigating enhancement opportunities; a resurvey of the reservoir would provide very useful information on the species abundance and distribution.

Conclusions in this fisheries summary chapter are based upon analysis from the strategic plan technical document, and from the recently released Omineca Sub-Region Fisheries Management Statement.

FISHERIES SUPPLY

The Finlay-Omineca unit contains more than half of the Omineca sub-region's small lakes, almost half of its rivers and streams, but is under-represented in terms of medium lakes (Table 4).

The Omineca Fisheries Management Statement estimates a maximum sustainable harvest for the unit of 483,000 fish (based on a success rate of 0.92 fish per angling day), a considerable increase over the present estimated harvest of 130,000. In general, however, fisheries supply information for the planning unit is currently inadequate. For example, Williston Reservoir started to fill in 1968, and reached full pondage in 1972. Fisheries abundance and distribution data were collected from the

TABLE 4

HABITAT TYPES AND CATCH IN FINLAY-OMINECA UNIT

Habitat Type	Number	Proportion Of Number In Omineca Sub-Region	Proportion of Planning Unit Catch -All Species	Proportion of Planning Unit Catch -Sport Fish Only*
Large lakes (>1000 ha)	20	33%	32%	33%
Medium lakes (>100<1000 ha)	91	5%	32%	34%
Small lakes (<100 ha)	2,547	53%	16%	18%
Rivers	22	47%	20%	15%

* Rainbow trout, Dolly Varden char, lake char, Arctic grayling and kokanee only.

SOURCE: Omineca Fisheries Management Statement.

reservoir in 1974-75, with results based on sampling over 15,000 fish. The most abundant sport species was lake whitefish, followed in order by mountain whitefish, rainbow trout, Arctic grayling and Dolly Varden char, among sport species. However, the characteristic decline in fish abundance which occurs in a new reservoir, and the expected change in species composition, may take from 4-30 years to occur. Since the surveys took place only 2 years after the reservoir was full, it is highly likely that fisheries composition of the reservoir has changed since those early surveys. The use of the reservoir by anglers to reach the best fishing locations at the mouths of streams has also undoubtedly reduced the supply of some of the sport fish species. In addition, the possibility of a commercial lake whitefish fishery being developed on the reservoir cannot be properly assessed without more current information.

During the same period as the reservoir fishery assessment, results of a survey of spawning habitat in streams tributary to the reservoir concluded that sufficient spawning habitat remained to support the reservoir's fishery. The Parsnip River was found to be the most important known spawning run for Williston Reservoir whitefish, and a later assessment of a B.C. Hydro proposal to divert the McGregor River concluded that this spawning run would be seriously affected should the project proceed.

Other fisheries supply data have been collected from the 80 lakes inventoried, and from a number of stream surveys which have been carried out in various areas throughout the unit. Finally, supply information is available through the lake stocking program, which involved release of nearly a million fish into 16 different lakes since 1968. In 1982, 11 lakes in the unit were stocked.

ANGLING ACTIVITY

The three factors which are of interest in examining present angling use are the amount of angling effort in the unit (in angler days), the number of fish caught, and the success rate (defined as the number of fish

caught per angler day). Detailed estimates of present angling activity in this planning unit are difficult to make due to the limited information that exists at the sub-regional level. For example, the 1980 National Survey of Sports Fishing provides excellent recent information at the regional level but contains very limited data on a site-specific basis. In addition, only a small number of creel surveys have been done in the planning unit.

According to the Omineca Fisheries Management Statement, anglers spent 141,100 days fishing in this unit during 1980, or about 25% of total angling effort in the Omineca-Peace Region for that year. Approximately three-quarters of this activity was by anglers who live in the Omineca-Peace Region, with the greatest proportion of these anglers living in the Prince George area, and smaller proportions coming from communities in the Peace River Planning Unit. There has been a significant increase in angling activity over the last ten years, in the order of about 10% per year. The greatest increase in effort has been by non-resident Canadian anglers.

Rainbow trout is the predominant sport species caught in the planning unit although whitefish, Dolly Varden char, lake char, and Arctic grayling are also important. Kokanee, burbot and brook trout (a stocked species) are among the other species caught. By habitat type, the majority of the catch is from large and medium lakes (especially Carp Lake and Williston Reservoir), and these proportions increase when sport fish species only are considered (Table 4).

The most important fisheries in the unit are on Carp Lake and Williston Reservoir. Carp Lake provides anglers with an excellent rainbow fishery. High priority has been placed on maintaining the quality of the angling experience on Carp Lake. In the case of Williston, most of the angling activity does not take place on the reservoir itself but rather at mouths of tributaries to the reservoir. In addition, winter fishing at the Bennett Dam appears to be quite popular even though a partial closure has been put into effect. Rainbow trout and grayling are the species most frequently caught on Williston, with smaller catches of whitefish and Dolly Varden.

What little information exists about angler success rates on Williston indicates that these are below the average for the planning unit, and recent reports by anglers suggest that they are deteriorating. This decline is particularly evident with grayling, rainbow trout, and large mature Dolly Varden char.

It has been estimated that 50-55% of angling effort in the planning unit during 1980 took place on Carp Lake and Williston Reservoir and its tributaries. Other medium to large lakes that provided important fishing were the Nation Lakes, (Tsayta, Indata, Tchentlo, and Chuchi), Witch and Germansen. Since so little is known about the amount of angling on these lakes and rivers, it is impossible to assess their relative contibutions.

The above discussion has been restricted to sport fishing with no mention of Native use. The Native food fishery is an important supplement to tne Native sustenance diet. At present, netting permits are issued by the Federal Department of Fisheries and Oceans on the recommendation of the Recreational Fisheries Branch. However, due to the uncertainty of whether the Native population of the planning unit falls under the terms of Treaty 8, few Natives perceive a necessity to apply for netting permits. As a consequence, the Recreational Fisheries Branch is aware that a considerable amount of netting takes place, on a variety of lakes, but has little information about the magnitude of this activity or the locations involved. However, it is suspected that in some lakes the native sustenance catch far exceeds the recreational sports fishery and may well exceed the natural productive capability of the system.

Estimates of success rates in the planning unit vary depending upon the assumptions which are used in the calculation. Based upon the results of the 1980 National Survey of Sports Fisning, which indicated a success rate of 2.5 fish per day for all anglers fishing in the Omincea-Peace Region, it might be concluded that success rates for Finlay-Omineca unit are approximately the same. The only recent, continuous creel survey in the unit is that for Carp Lake, which between 1974 and 1982, but omitting a high

rate for 1978, has averaged 2.3 fish per day. A 1977 Williston Reservoir creel survey found a success rate of 1.37 fish per day, but this has undoubtedly declined since that time. The Omineca Fisheries Management Statement estimates a planning unit average of 0.92 fish per day, varying depending upon habitat type (Table 5). Catch is also shown in Table 5. The differences in estimates between the two approaches can be taken as an indication of the inadequacy of available information, and as support for the need for more extensive and up-to-date data.

PROJECTED ANGLING ACTIVITY

The Omineca Fisheries Statement forecasts 198,000 angler days will be spent in the Finlay-Omineca unit in 1990, a 40.6% increase over the estimated 141,000 in 1980. Using a success rate of 1.5 fish per day as an objective for 1990, and a 1980 success rate of 0.92, the planning unit will be required to provide a 1990 harvest of 298,000 fish, a 230% increase over the 1980 harvest.

In all cases shown in Table 6, the maximum sustainable yield is 1.7 or more times the target harvest, suggesting the Finlay-Omineca unit will be able to meet the target harvest. However, since much of the planning unit is currently inaccessible to anglers, this apparent surplus likely translates into a shortfall in some of the most accessible lakes, depending upon availability of fish for stocking.

This is particularly the case for the "boom and bust" fisheries of the small lakes which are especially numerous in Finlay-Omineca, where the source of both fish supply and angling pressure exhibits a geographical progression as new vehicle access is constructed for resource industry purposes. The result is a shift of interest to more and more distant lakes, and for this reason, inventory of lakes before they become available to large numbers of anglers is important.

TABLE 5

PRESENT AND PROJECTED ANGLING DEMAND FOR PRIORITY SPORT FISH*
IN FINLAY-OMINECA UNIT

	1980			1990		
	Angler-days	Catch	Success Rate	Angler-days	Catch	Success Rate
Large Lakes	46 800	43 100	0.92	67 800	101 700	1.5
Medium Lakes	44 200	43 800	0.99	63 600	95 500	1.5
Small Lakes	22 800	22 800	1.00	32 000	48 000	1.5
Rivers	27 300	19 900	0.73	35 000	52 400	1.5
Totals	141 100	129 600	0.92	198 400	297 600	1.5

* As in Table 4.
SOURCE: Omineca Fisheries Management Statement.

In future years, it is likely that angling effort will be more evenly distributed throughout the planning unit as the construction of mining and logging roads opens up the presently inaccessible northern parts of the planning unit. A recent increase in angling guide activity has occurred, with a total of eleven licenses issued for the planning unit for the 1982-83 season. It is expected that this activity will continue to increase in future years.

CONCLUSIONS

From Table 6, it is evident that sound knowledge of success rates is fundamental to fisheries management planning. Although in all cases the table indicates a surplus of fish to meet 1990 catch targets, this is partly a product of the methods of calculating maximum sustainable yield and production, and better success rate information is desirable to refine these figures. Continuation of the Carp Lake creel survey is important, as are up-to-date angler use estimates for Williston Reservoir, since those two fisheries together constitute over half of the angling use in the planning unit. Ideally, additional creel surveys in other parts of the unit would be undertaken to refine the success rate estimates for the planning unit, but this may not be possible given current staffing levels.

Despite overall indications of an adequate supply of fish in the planning unit, much of this supply is in areas which are difficult for anglers to reach. In the accessible areas of the unit, increased angling activity resulting from the combination of access provided by the reservoir, and via industrial roads (see Figure 4), has led to harvests which exceed production. The extent of this overharvesting is unknown. Fisheries management decisions have therefore been conservative in nature, to protect the resource from over-exploitation, and have led to fishery closures on a number of Williston tributaries.

Although a fisheries productivity model has not yet been developed for the northern lakes typical of this planning unit, it is important that lake inventories continue to be carried out, particularly for lakes which will likely become accessible to anglers in the near future, as resource industry activities occur throughout the unit. Information derived during these inventories will permit appropriate management of these "new" lakes so that they may avoid the "boom and bust" fishery typified by excellent fishing immediately following access development, but a declining fishery shortly thereafter. Fish productivity rates in northern lakes simply cannot keep up with demand.

TABLE 6

CURRENT AND PROJECTED SUPPLY AND CATCH OF PRIORITY SPORT FISH AT VARIOUS SUCCESS RATES

1980			Maximum	1990		
Effort (thousand angler days)	Success Rate (fish/day)	Catch (thousand fish)	Sustainable Yield (thousand fish/year)	Projected Effort (thousand angler days)	Target Success Rate (fish/day)	Target Catch (thousand fish)
141	0.92	130	484	198	0.92	183
141	0.92	130	484	198	1.5	298
141	1.5	212	791	198	1.5	298
141	2.0	282	1054	198	2.0	397
141	2.5	353	1318	198	2.5	496

Finally, it is clear that a number of the most accessible lakes in the southern part of the unit will continue to experience heavier use than can be naturally supplied, and an expanding stocking program will be required to meet this demand. However, the single most pressing need identified through the supply/demand analysis is for the re-survey of Williston Reservoir, using methods which make possible a comparison to results of the earlier survey.

3.3 MANAGEMENT OBJECTIVES

Until more creel survey information allows a refinement of the estimated planning unit success rate, the conservative approach is to use the lowest success rate (0.92) available, and plan fisheries objectives based on calculations using this number. This suggests that using a 1990 target success rate of 1.5 fish per day, nearly 300,000 fish per year will be caught in the unit by 1990 (Table 6), a little more than half the estimated sustainable yield. Even though not much more than half of the unit is presently accessible to anglers, the current estimated surplus should still be sufficient to meet a target success of 1.5 fish per day. However, the most heavily angled lakes will require increased stocking to sustain this success rate.

With respect to Williston Reservoir, the largest body of fresh water in the province, the absence of recent inventory requires an assumption that populations of sport fish have declined in the past decade, and until inventory and subsequent management are able to reverse this trend, conservative measures will be applied to attempt to halt the decline.

3.4 MANAGEMENT OPTIONS

The first priority of the Ministry is to continue to meet its legislative responsibility of administering the regional fisheries program. This includes the setting of regulations, issuance of permits, and response to referrals from other agencies.

The next most important priority relates to Williston Reservoir and the need for up-to-date information on both fisheries supply and angling use. The water licence issued in 1962 for this project contained a clause which stated that the developer can be requested to provide remedial measures to rectify any fishery loss.[1] It is clear that the Williston fisheries assessment is a major undertaking which will only be possible when sufficient staff and budget are available. In the absence of better information which will lead to positive fisheries management of this large waterbody, the future for angling on the reservoir points to a continually increasing use of restrictive regulations, to protect the resource. Towards this end, a fisheries management plan[2] has been developed for discussion with B.C. Hydro.

Another management option relates to the lack of inventory information on a fairly large number of the planning unit's lakes. It is important that better knowledge of fisheries in these lakes be obtained before they become accessible to anglers. Figure 4 illustrates the degree of access which will soon exist in the unit. Improved fisheries information in these areas will lead to appropriate management and regulations specific to each lake, designed to reduce the "boom and bust" pattern of these low productivity lakes.

The necessity to respond to more intense angling pressure on accessible lakes near population centres (i.e. in the southern part of the planning unit, and near Mackenzie) has resulted for a number of years in a stocking program. It is apparent this program should be continued and expanded.

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[1] Appendix 2 contains the fisheries management program which forms part of the compensation agreement agreed with B.C. Hydro.

[2] Ableson, D. 1982. Williston Reservoir Fisheries Assessment. Fish and Wildlife Branch, Prince George.

Finally, the situation respecting the Native sustenance fishery should be clarified, both as regards the applicability of Treaty 8, and the quantification of this component of fishery use. In the meantime, regional staff should attempt to reach a mutual understanding with the Natives of Native lifestyle and fisheries sustained yield principles.

In summary, although the Omineca fisheries management statement concludes there is a sufficient supply of fish in the planning unit at least until 1990 (at a success rate of 1.5 fish per angler day), much of this potential supply is currently inaccessible. For those areas which can be reached by anglers, there exists a possibility that success rates will drop below 1.5 due to a shortage of supply for the amount of angling. Williston Reservoir success rates are already low, and they are presumably declining further. This points to the need for a better understanding of the resource, through inventory, followed by appropriate management. To maintain a supply of fish in the most heavily fished lakes, stocking is required. For those lakes anticipated to be accessible in the near future, fisheries supply and productivity need to be assessed before they are overfished, due to management based on inadequate information.

3.5 MANAGEMENT PLAN (See Figure 6)[1]

1. Williston Reservoir assessment (Table 7)

A three-part fisheries assessment of the Reservoir will be initiated as soon as funds become available. It includes the following components:

a. annual creel survey;
b. annual netting program;
c. annual limnological program.

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[1] Consult Appendix 2 for details of the fisheries program agreed to with B.C. Hydro.

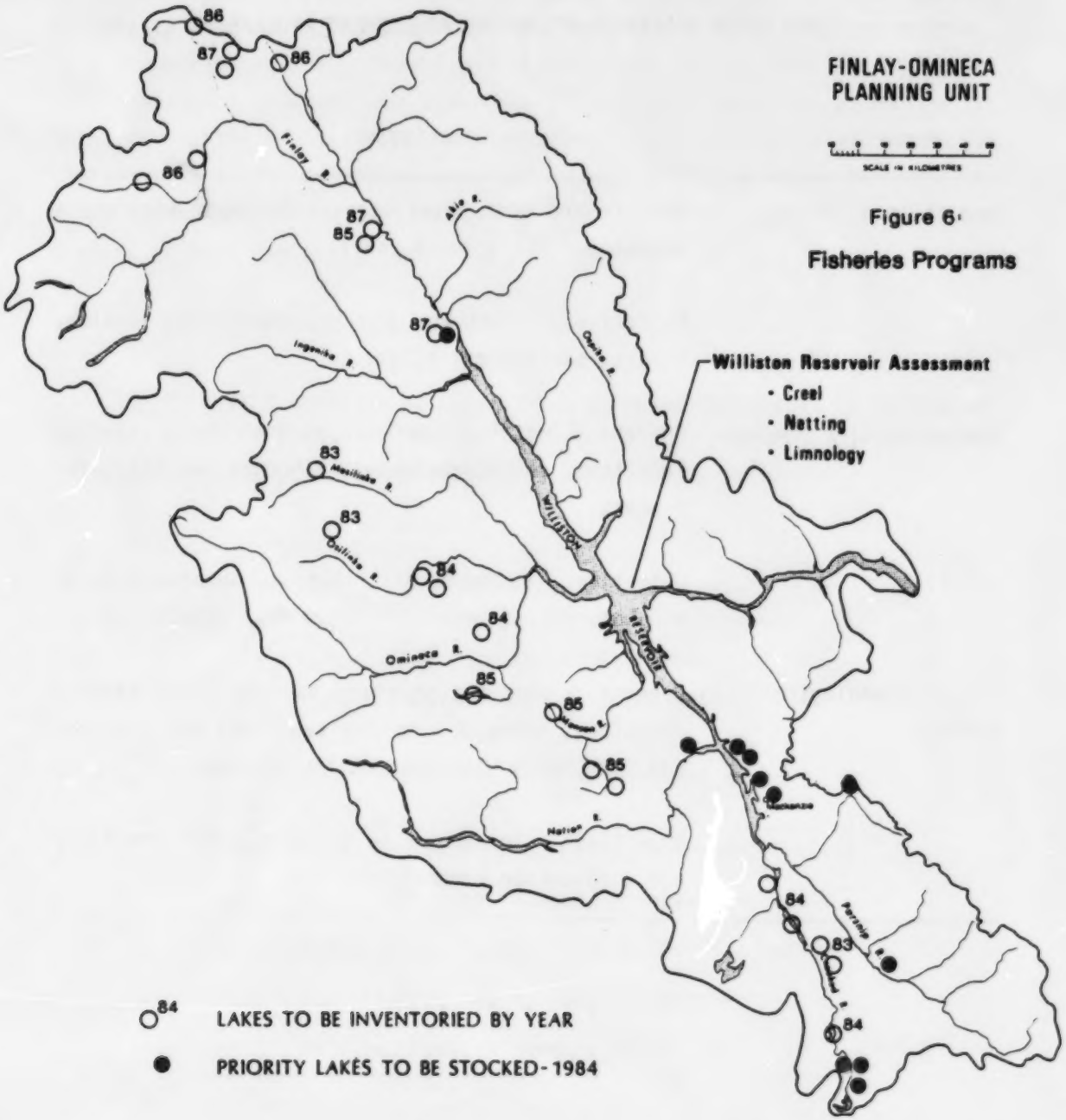
FINLAY-OMINECA
PLANNING UNIT
SCALE IN KILOMETRES
Figure 6:
Fisheries Programs
Williston Reservoir Assessment
• Creel
• Netting
• Limnology
Finlay R.
Akie R.
Ingenika R.
Omenica R.
Misilliza R.
Osilinka R.
Ominoca R.
Nation R.
Parsnip R.
WILLISTON
RESERVOIR
86
87
85
83
84
○84 LAKES TO BE INVENTORIED BY YEAR
● PRIORITY LAKES TO BE STOCKED-1984

TABLE 7

WILLISTON RESERVOIR FISHERIES ASSESSMENT PROGRAM

Activity	Description
Annual Creel Survey	Vehicle and boat creel surveys for approximately 4 months per year, for 5 years.
	Objective: Estimate angling statistics (catch, effort, success rates, etc.).
Annual Netting Program	Operate 9 netting stations at previously studied locations, for approximately 4 months per year, for 5 years.
	Objective: Estimate distribution, abundance, size and maturity of reservoir sport fish populations.
Annual Limnological Program	Operate 9 sampling stations at previously studied locations, using 3 sampling sequences per station, and coinciding with the netting program.
	Objective: To determine present water chemistry and zooplankton composition.

The program is designed to continue for 5 years, and will provide comparability with 1974-75 results by carrying out the same sampling program, in the same locations. Should additional funds not be made available for this assessment program, the reservoir fishery will continue to decline in terms of angling success rate, and the trend to closures of stream mouths to fishing will continue. Based upon information collected under this assessment, corrective management programs will be undertaken to improve the fishery of this regionally important body of water.

2. Lake inventory program (Table 8)

The following schedule outlines lakes selected for inventory during the next 5 years. Additional lakes which require inventory are listed in the technical report, but they have not been scheduled by year.

TABLE 8
FIVE-YEAR LAKE INVENTORY PROGRAM
FOR FINLAY-OMINECA PLANNING UNIT

Year	Lakes
1983	Aiken, Burden, Dina, Firth, Hourston, Tutizzi
1984	Davy, Germansen, Manson, McIntyre, McLeod
1985	Munro, Nina, Skunk, Stelkuz, Uslika, Wasi
1986	Fox, Fishing Lakes, Obo, Toodoggone
1987	Estella, Foot, Ridgeway, Spinel

3. Lake stocking program (Table 9)

The proposed stocking program, including priority order, is given below for 1984. Approximate numbers of fish desired for the next few years are known, but have not been assigned to specific lakes, to maintain management flexibility. Stocking will continue to be directed at small, and to a lesser extent medium, sized lakes; no rivers or streams will be stocked. Priority fish species will be rainbow trout and brook trout, with lesser attention directed to lake char and Dolly Varden char.

TABLE 9

STOCKING PROGRAM FOR LAKES IN FINLAY-OMINECA DURING 1984

Lake	No. of Fish	Management Unit	Regional Priority and Rank
1. Rainbow trout - spring stocking			
Hart	5,000	7-16	1(1)
Emerald	5,000	7-16	1(3)
Ed Bird	5,000	7-40	1(4)
Morfee	15,000	7-30	1(8)
Azouzetta	5,000	7-22	1(13)
Burden	10,000	7-29	1(16)
Heather	5,000	7-29	1(22)
Crystal	5,000	7-16	2(1)
Goose	5,000	7-16	2(2)
Hambone	5,000	7-16	2(3)
Morfee	10,000	7-30	3(2)
2. Rainbow trout - fall stocking			
Squaw	2,500	7-16	1(1)
Fern	2,500	7-23	1(2)
Ed Bird	5,000	7-40	1(8)
3. Brook trout - spring stocking			
Gantahaz	15,000	7-30	1(1)
Dina	10,000	7-30	1(7)

4. Carp Lake creel survey

The annual creel survey on Carp Lake, probably the most important fisheries lake in the region, should continue to be carried out, supported by the Provincial Parks Branch. If funding from that source is not available the creel survey can not be continued. This would be particularly regrettable, given the general lack of creel survey data in the planning unit.

5. Detailed fisheries assessment

All lakes which are chosen for stocking will be subject to stocking assessment evaluations, in order to maximize benefits from the stocking program.

Enhancement opportunities will be identified, programs developed, and implemented on specific small and medium sized lakes. These programs include removal of barriers to fish passage (e.g., Ed Bird and Azouzetta Lakes), general habitat complexing in tributary streams to improve spawning and rearing capability for rainbow trout (e.g., Lyons and Tobin Lakes), lake rehabilitations (e.g., Hart Lake was treated in 1982), and life history and population dynamic studies.

4. WATER MANAGEMENT

4.1 WATER MANAGEMENT PROGRAM OBJECTIVES

The goal of the water management program is to manage the water resources of the Province so that the greatest possible economic, social and recreational benefits can be realized by its residents, through reduced flooding and a supply of water which is plentiful and of good quality. This goal is met by:

1. allocating and regulating the use and supply of water through a licensing system;
2. preserving or enhancing water quality;
3. reducing the potential for loss of life and property damage caused by erosion and flooding;
4. ensuring an appropriate level of health engineering and technical standards for water supply systems, and regulating privately owned water utilities;
5. providing information on the capability of the resource to meet water supply and other needs.

Achievement of this goal requires management which takes into account both surface and groundwater, and also the quantity and quality requirements for fisheries, waste management, and recreational purposes, as well as for licensed industrial, commercial and municipal uses.

In a few areas of the Province, the supply aspect of the first objective is close to being totally allocated, but this is not the case in the Finlay-Omineca unit. On a planning unit or sub-basin level, an early assessment indicated water supply exceeded licensed demand.

The second objective, relating to water quality, is addressed in Section 5 of this report.

The major shortcoming for this unit is related to objectives 3 and 5, in that basic hydrometric information for some parts of the unit is not available. Peak flow information for most of the tributaries in the planning unit is insufficiently precise for the Regional Water Manager to be able to assist companies in the design of bridges and culverts for the construction of roads into undeveloped areas and for minesite development. There is therefore a need for a review of the existing hydrometric gauging network in the unit, to identify potential new gauge sites which would provide surface flow information useful in the future.

The third objective, relating to the potential for loss of life or property, is of concern in this planning unit, not specifically as it relates to erosion or flooding, but involving the considerable hazard to recreational and industrial navigation existing on Williston Reservoir. This results from debris caused by flooded forest dating to reservoir creation in the 1960s, and to the continuing entry of timber as slumping occurs along the reservoir shoreline.

4.2 ANALYSIS

Analysis showed that the 45 water licences and approvals in the planning unit as of the end of June 1982 are mainly situated in the southern half of the unit, and are concentrated between Mackenzie and Summit Lake, and in the Omineca River Valley. In general terms, to adequately assess the water supply/demand balance it is necessary to know the amount of licensed use, the actual amount of withdrawals under the licences, and the proportion of water withdrawn which is consumed (i.e., not returned to the system). In the Finlay-Omineca unit no evidence has been found to indicate any water shortage problems so that an analysis involving that level of detail is unnecessary. Additionally, a summary of groundwater well records contained information on 39 wells, many of them in the Crooked River Valley, and determined the potential for a viable, potable water supply from groundwater sources to be favourable in the Mackenzie-Summit Lake corridor. It is clear that water supply greatly exceeds licensed withdrawal and in-stream

requirements in general, and a drastic reversal of this situation is not anticipated for the planning horizon.

A peak flow regionalization analysis showed that the southeastern region of the unit (Misinchinka and Hart Ranges) has higher peak flows than the rest of the unit. The analysis also provided instantaneous peak flow estimates, which can be used by the Regional Water Manager in providing estimates of flows for bridge and culvert design purposes. However, many of the gauge records are for too short a period for confident projections. The analysis also identified potential future gauging sites for filling the current small-stream information gaps. These were chosen on the basis of proximity to resource use areas and site accessibility, in addition to drainage area. The relative scarcity of gauging stations in the northern parts of the unit, particularly in smaller watersheds, is evident from a comparison of Figures 4 and 7.

Finally, a review of progress on Williston Reservoir debris clean-up indicated that a regional Sub-Committee consisting of members from the Ministries of Environment and Forests, and from B.C. Hydro, is working toward a 1988 deadline of substantial debris removal. Achievement of this goal would result in removal of the floating debris plug in the Finlay River mouth area, and greatly lessen the present navigational hazard. This committee reports to a Provincial committee comprised of the same agencies.

4.3 MANAGEMENT OBJECTIVES

During the next five years, three main requirements for the Water Management Program were identified. The first is the continuing necessity of administering the Water Act, which includes adjudicating applications for licences and approvals as they are filed, and providing limited monitoring of existing water use. This includes field inspections of licence applications, and inspection and monitoring of existing licences. The largest proportion of this workload at present relates to placer mining approvals. The activities of the forest industry also directly affect staff time, since

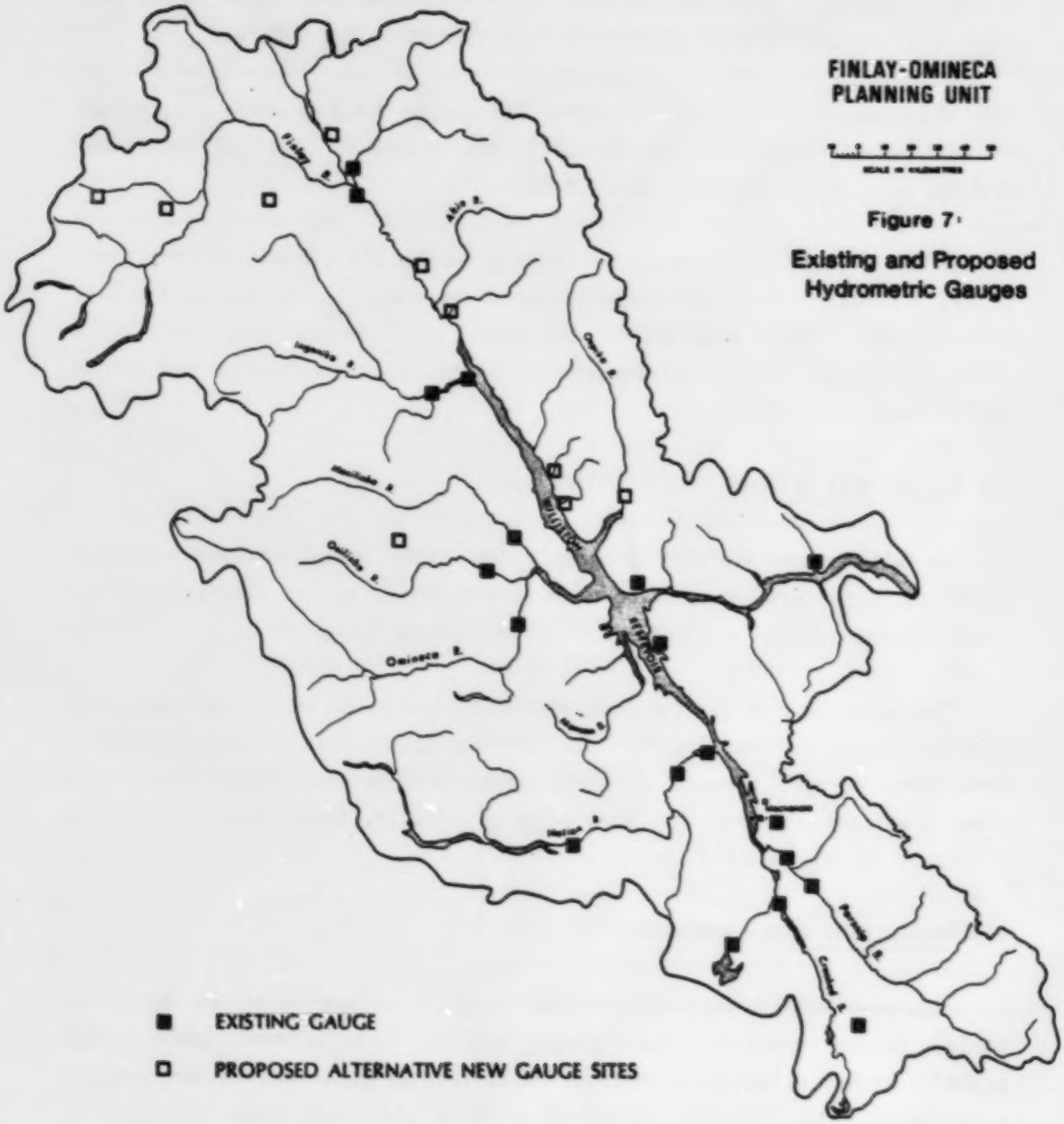

Figure 7.

Existing and Proposed Hydrometric Gauges

design input is required for bridges and culverts when new forest roads are built. Development of such projects as the Cirque and Carbon Creek coal mines will require greater staff time commitments in the future.

A second requirement of the Water Management Program which must be met is continuing involvement on the Williston Reservoir clean-up committee. This is expected to continue through 1988.

A third requirement involves the implementation of some of the additional hydrometric stations recommended in the analysis, to expand the data base for small-stream watersheds. This would allow better peak flow predictions in future, and therefore more accurate input to culvert and bridge design requests.

4.4 MANAGEMENT OPTIONS

As with other Ministry programs, the basic administrative functions under the Water Act of managing water withdrawals, stream alterations, and water storage must be met and cannot be considered an option.

The major option available is the installation of new stream gauges to provide better information for smaller watersheds than is now available. Other than through the use of regionalized information derived from large rivers, which is at best only marginally applicable, there is no alternative to obtaining this level of detail.

4.5 MANAGEMENT PLAN (Table 10)

New hydrometric stations will be installed according to the following table, in the priority order given, and as funds are available. The priority order is based upon anticipated developmental trends and present scarcity of data. General locations of these sites are shown in Figure 7. In terms of future development, the Jock and Lawyers Creek sites, where these sites join the Toodoggone River, are probably the most important of all alternatives, but access is currently by air only.

TABLE 10

PROPOSED ALTERNATIVE HYDROMETRIC SITES
IN NORTHERN PART OF FINLAY-OMINECA PLANNING UNIT

PRIORITY LEVEL	AREA WITHIN PLANNING UNIT	PROPOSED HYDROMETRIC SITE	DRAINAGE AREA (km^2)	MEDIAN ELEVATION (m)
1	Finlay-Fox	One of:		
		Bower Cr. tributary	98	1590
		Bower Cr. tributary	230	1870
		Carcajou Creek	165	1200
		Jock Creek*	145	1270
		Kwadacha River	14	1090
		Lawyers Creek*	96	1360
2	Akie	One of:		
		Del Creek	254	1260
		Finlay R. tributary	74	1100
		Pesika Creek	684	1500
		Davis Creek	468	1430
		Bruin Creek	147	1410
3	Ospika	One of:		
		Aley Creek	148	1470
		Ospika R. tributary	81	1330
		Ospika R. tributary	133	1520
		Gauvreau Creek	209	1520
4	Osilinka-Omineca	One of:		
		Tenakihi Creek	127	1360
		Tenakihi Creek	189	1350

* accessible by air only.

5. WATER QUALITY MANAGEMENT

5.1 WATER QUALITY MANAGEMENT OBJECTIVES

The management of water quality in the Province is the responsibility of two Ministry programs: the Water Management Program and the Waste Management Program. The Water Program is responsible for setting priority uses and establishing appropriate levels of water quality through the establishment of water quality objectives. The Waste Program is responsible, through regulating waste discharge, for ensuring that those levels are maintained. The major mechanism of water quality regulation is permits which specify requirements for discharge quality, issued through regional operations under the authority of the Waste Management Act.

The Water Management Program goal refers in part to the provision of water of good quality for the greatest possible economic, social and recreational benefits, with one of its objectives being: to preserve or enhance water quality.

The Waste Management Program goal is to protect the environment of British Columbia by controlling the impact of polluting substances. The objective of this program which affects water quality concerns is: to preserve the quality of the water environment of the Province at or above acceptable levels by managing the discharge of pollutants.

This objective is to be achieved through:

- trend analyses of water quality at selected sites throughout the Province;
- inventory of effluent discharges (permitted/not permitted);
- progress in regulation (compliance/non-complicance).

In practice, Waste Management staff issue permits to allow waste discharges, after ensuring that such discharges will meet certain environmental quality criteria. The Water Management Branch role in the maintenance of water quality involves establishing explicit water quality objectives for specific water systems, based on a designation of the priority water uses in the area. These uses may be consumptive (e.g., for domestic or industrial use), or instream (e.g., fisheries or recreation). Establishment of the water quality objectives involves examination of natural and existing quality of the system, determination of existing sources of pollution, designation of the important water uses of the system, comparison with provincial criteria for designated uses, and the establishment of appropriate water quality objectives based on these considerations.

In the Finlay-Omineca unit, several existing and potential water quality concerns were investigated in relation to the objectives of the two programs listed above (Figure 8).

5.2 ANALYSIS

In determining water quality objectives, analysts subdivided the Finlay-Omineca unit into seven sub-basins (Figure 8), three of which contained water quality issues of sufficient priority that they were addressed in the strategic plan. Analysis led to the conclusions, recommendations and provisional water quality objectives summarized below.

UPPER FINLAY SUB-BASIN

This sub-basin is currently largely undeveloped wilderness, with low human population, but with a high potential for future mineral resource development. The only activity in this area which has recently impacted water quality was a gold and silver mine (the Baker Mine) operated by DuPont of Canada, until its closure in November, 1983. Evidence of environmental alteration was apparent within the mine vicinity, and permit non-compliance

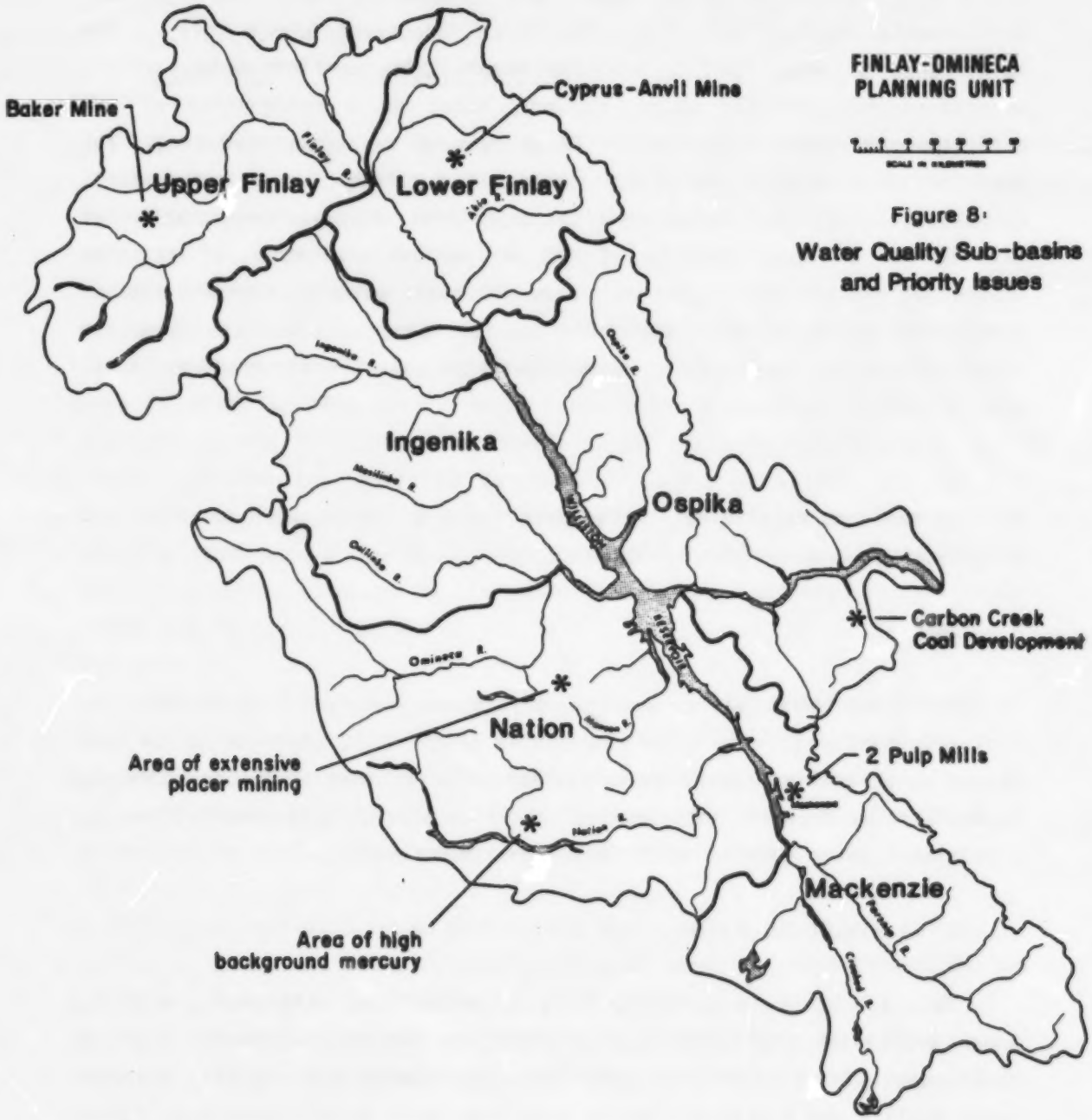

Figure 8:
Water Quality Sub-basins
and Priority Issues

by the mine operator led to successful legal proceedings against the permit holder in 1982.

The gold and silver extraction procedure involved cyanidation, and the tailings were discharged to a pond which exfiltrated into an adjacent stream. During the 32 months of operation, the open pit/waste rock, mine camp sewage, and tailings discharge have resulted in the following:

a. concentrations of cyanide and copper in excess of the waste discharge permit levels, and water quality criteria for the protection of aquatic life in receiving waters.

b. concentrations of nitrite in excess of water quality criteria for aquatic life.

c. excessive suspended solids, B.O.D., and fecal coliforms from the camp sewage discharge.

The effluent permit (PE 5809) was amended December 22, 1983 to reflect changes that the operation phase had revealed to be necessary. The possibility of a tailings pond positive discharge was removed and new effluent standards were set.

Due to the remote location and the natural absence of fish in the affected waters, there was little conflict with other water uses. The affected creeks, which include Galen and Jock Creeks, are largely devoid of fish due to migration barriers. However, the Recreational Fisheries Branch considers this system excellent fish habitat and intends to stock it when water quality improves. Furthermore, it is likely that non-fish aquatic life has been impacted by the mine tailings, although this is difficult to demonstrate since few water quality criteria are relevant to aquatic life other than fish.

In the event that the mill reopens, provisional water quality objectives will be available for cyanide, copper and nitrite and for most other variables recommended for monitoring to protect the aquatic life of Galen and Jock Creeks. These objectives are set for a point approximately 4 km downstream of the mine to protect the fish stocked by the Recreational Fisheries Branch, or the fishery potential should stocking occur at a later date. The relatively long dilution zone is considered necessary due to the low dilution capacity of this headwater alpine creek. Nevertheless, these objectives ensure that the majority of the best fish habitat in Galen Creek and all of Jock Creek are protected.

Should the mill reopen, modifications to the recently amended permittee monitoring requirements are proposed to define more clearly the extent of pollution and to assist in future waste management. This includes the addition of certain variables, increased monitoring frequency and changes to the monitoring sites used. The additional monitoring proposed includes stream flow measurement of Galen Creek and the addition of variables such as nitrogen, mercury, residual chlorine, non-filterable residue, hardness and temperature. Initial monitoring of mercury is recommended to determine if mining operations enhance what may be already naturally elevated mercury levels.

LOWER FINLAY SUB-BASIN

This sub-basin is also very sparsely inhabited, with no licenced waste discharges at present. Water uses are limited to minor domestic withdrawals (by a few residents near the mouths of Paul and Akie Rivers, mine developers at Cyprus Anvil's Finbow base camp, and trappers, prospectors and game outfitters), and for sport and native food fishing. Three concerns were addressed in this sub-basin: mercury content in some food fish; the Cirque project (a proposed lead-zinc mine near the Paul River); and widespread logging operations scheduled to commence in 1985.

a. Mercury in Fish Tissue

A current water quality issue relates to the natural levels of mercury found in a number of locations in the planning unit. Health and Welfare Canada has recorded levels of mercury in fish tissue (Dolly Varden) approaching the commercial fisheries limit of 0.5 ppm. This has prompted that agency to issue a precautionary warning to natives in the Fort Ware area against excessive consumption of Dolly Varden from the Finlay River. Available water quality data suggest that similar mercury levels may be encountered in Dolly Varden in other areas of the sub-basin. Although no medical problems due to traditional fish consumption levels have been identified, the Ministry of Environment supports the Health and Welfare Canada recommendation to periodically test the population of Fort Ware and food fish in the vicinity. A comprehensive mercury analysis of all food fish species in any area of the sub-basin scheduled for developemnt should be carried out.

b. Cirque Project: Proposed Lead-Zinc Mine

Cyprus Anvil Mining Corporation's Cirque property on the Paul River was scheduled for development in the near future; however, currently depressed metal prices have prompted the company to halt minesite preparation and environmental studies in the area. As of late 1984, the company had not yet entered Stage I of the Metal Mine Development Guidelines, although some water quality monitoring has been carried out.

Potential contaminants which could result from the proposed mine operation include turbidity, suspended solids, heavy metals (e.g., aluminum, cadmium, copper, lead, mercury, silver, zinc), acid drainage, nitrogen from blasting, and processing reagents such as cyanide. Baseline water quality information for the Finlay River, Paul River, Del Creek and Akie River has shown that several of these potential contaminants (aluminum, cadmium, copper, cyanide, iron, mercury and zinc) at times exceed criteria recommended for aquatic life.

Additional water quality monitoring is recommended during the environmental impact assessment for the Cirque Project, for impact prediction and to establish baseline levels of potential contaminants for use in developing water quality objectives for the project. This monitoring would be conducted by the proponents, with guidance from the Ministry of Environment.

Water quality objectives for the Cirque Project area are not proposed at this time. It is recommended that site-specific objectives for the Paul River basin be developed during the latter stages of the impact assessment for the project when considerably more information will be available on water uses, natural water quality, and projected impacts on water quality. This does not prevent the Ministry from designating the water uses to be protected in the Paul River basin if sufficient information is currently available, but the establishment of numerical objectives to protect those water uses must await better site-specific information.

c. Proposed Logging Activities

Large-scale logging operations could commence for the first time in the Lower Finlay Sub-basin as early as 1985, and continue well into the next decade. The potential impacts from this activity are increased water temperatures, soil erosion, increased runoff, and sedimentation of the streams in the basin. Increased soil disturbance may also promote the release of greater amounts of nutrients and heavy metals (e.g., mercury can already be at levels that exceed aquatic life criteria).

Forestry-related water quality effects could be additive with those resulting from potential mining operations in the region. It is recommended that harvesting techniques employed be of a type which minimize surface disturbance. For example, in the Paul River watershed, using an elevated log retrieval system such as a skyline cable would be preferable to skidding. Other useful soil management techniques include leaving reserve strips of vegetation along stream banks, and locating roads in the most stabilized locations.

Water quality objectives for future logging activities are not proposed at this time. To establish objectives, site-specific information about the basins to be logged, the natural water quality, and the water uses to be protected would be required. If the Ministry wishes to establish water quality objectives for logging activities, this information could be collected during the development of logging plans. However, it would be very costly to collect the background information and perform the analysis.

MACKENZIE SUB-BASIN

This analyis is in progress, with a first draft expected by August, 1984. It will concentrate on the two pulp mills in the Mackenzie area and the Mackenzie sewage treatment plant.

5.3 MANAGEMENT OBJECTIVES

Should the Baker Mine reopen, frequent inspections and monitoring will be required to ensure that compliance with the amended permit is maintained and damage to the aquatic systems is prevented. In the event that the mine does not reopen, the equipment must be removed and the mine properly reclaimed to restore the aesthetic value and promote restoration of the sensitive alpine environment. For the Cirque and Carbon Creek mine proposals, cooperation between the Ministry and mine developers should be utilized so that an appropriate monitoring network is set up at each location, including sampling for parameters recommended by the Ministry. For the two pulp mills at Mackenzie, continued progress towards complete permit compliance and refinement of receiving environment programs are the main objectives.

5.4 MANAGEMENT OPTIONS

Cooperative interaction between the Ministry and industry should allow attainment of the above objectives. For the two proposed mines, adequate

data bases are necessary before operations commence, to provide the necessary background to ascertain in future whether water quality is being affected.

5.5 MANAGEMENT PLAN

UPPER FINLAY SUB-BASIN (Table 11)

The December 22, 1983 amendment to the Baker Mine permit included many changes which had become required as a result of experience in the operations phase of the mine. Should the mine reopen, the recommendations in Table 11 will further assist in future waste management at the mine. Should the mine and mill remain closed, the reclamation of the area will be inspected by a regional team (Waste Management, Fish and Wildlife Habitat Section, and a Mines representative) to ensure that it is satisfactory. This is a requirement of the Ministry of Energy, Mines and Petroleum Resources and is also in the Waste Management Permit.

A final recommendation which applies to all of the Upper Finlay Sub-Basin is that mercury monitoring be carried out as part of any future environmental assessment prior to resource developments, and be included in monitoring requirements during operation. In addition, new sites added to the hydrometric monitoring network should be located nearer to areas subject to present and future resource developments, specifically the Toodoggone River drainage (see Figure 7).

LOWER FINLAY SUB-BASIN

Additional monitoring recommended for the Cirque Mine is shown in Table 12.

TABLE 11
PROPOSED MODIFICATIONS TO THE BAKER MINE EFFLUENT PERMIT AND MONITORING RECOMMENDATIONS

a. Establish a weekly water flow monitoring station slightly upstream of the tailings pond. Although downstream monitoring will occur weekly, this flow data could assist in dilution calculations and further management options, should the need arise.

b. Test for total hardness.

c. Regularly monitor for total mercury to see whether mining activities are enhancing background levels.

d. Report residual chlorine.

e. Levels of inorganic nitrogen are not expected to be a problem with the switch to the Inco system. However, Waste Management could periodically check the levels of ammonia, nitrite and nitrate to confirm this.

TABLE 12

ADDITIONAL MONITORING RECOMMENDED FOR THE CIRQUE PROJECT

Alkalinity
Flow
Hardness
pH
Suspended solids
Temperature
Turbidity
Aluminum, Dissolved and Total
Cadmium, Dissolved and Total (detection limit of 0.5 ug/L or lower)
Copper, Dissolved and Total (detection limit of 1 ug/L or lower)
Cyanide, Total (detection limit of 5 ug/L or lower)
Lead, Dissolved and Total
Mercury, Total (detection limit of 0.05 ug/L)
Silver, Dissolved and Total (detection limit of 0.1 ug/L or lower)
Zinc, Dissolved and Total (detection limit of 0.1 ug/L or lower)
Radionuclides; radium-266, strontium-90, iodine-129, iodine-131
Nitrogen - Ammonia
- Nitrate
- Nitrite
Phosphorous - Ortho-phosphorous, Dissolved (detection limit of 3 ug/L or lower)
- Total Dissolved
- Total
Nitrogen: Phosphorous ratio in periphyton tissue

The levels of important metals such as those listed above should also be considered for measurement in periphyton, benthic invertebrates, stream sediments, groundwater, and fish tissue (mercury only). Metallothionein measurements in fish livers should be considered with regard to the other heavy metals. Aquatic life and sediments are generally more sensitive indicators of increasing metal levels in the environment than water.

To address the question of elevated mercury levels in fish, it is recommended that Health and Welfare Canada be encouraged to continue its program of monitoring mercury levels in humans and food fish both near Ware, and in other areas of the sub-basin scheduled for development in the future.

For water quality concerns related to logging practices, the Ministry will establish closer liaison with Ministry of Forests regional staff to lead to more suitable site-specific logging techniques. These would be designed to minimize soil disturbance and would include leaving reserve strips of streamside vegetation.

6. AIR QUALITY

6.1 AIR QUALITY MANAGEMENT OBJECTIVES

Air quality management, somewhat in parallel to that for water quality, is the concern of two Ministry programs, Waste Management and Air Management. The Waste Management Program goal with respect to airborne substances is: to preserve the quality of the air in the Province at or above acceptable levels by managing the discharges of pollutants to the atmosphere.

This objective is to be achieved through:

- trend analyses of air quality at selected sites throughout the Province;
- statistics on ambient air excursions;
- inventory of emission sources (permitted vs. not permitted);
- progress in regulating emissions (compliance/non-compliance).

As is the case for effluents to water, the Waste Management Branch also issues permits for air emissions.

The Ministry's Air Management Program has as its goal: to maintain atmospheric quality in British Columbia at a level which is conducive to good health and a quality environment; to provide atmospheric information necessary for the management of British Columbia's resources.

Objectives to meet this goal are:

1. To establish air quality standards and to monitor major airsheds in the Province to ensure the standards are maintained.

2. To develop and implement airshed management systems to ensure air quality which is conducive to good health and to maintenance of the Province's natural resources.

3. To provide atmospheric data and expert services to Ministry programs and other agencies.

4. To regulate weather modification.

Although there is some concern in this planning unit regarding permit compliance, and with logging slash burning (which does not fall under the Waste Management Act), the objective which includes projected air quality is the most relevant one in the Finlay-Omineca unit. With a number of air emission permits currently issued to the forest industry in the Mackenzie area, there was a desire to assess the dispersal potential of the local airshed in case more permits are requested in the future.

6.2 ANALYSIS

No ambient air quality monitoring station other than for dustfall exists either in the Mackenzie area, or elsewhere in the planning unit, so that only limited assessments of trends in air quality over time can be made in an objective way, and these must rely on permittee monitoring data. Of the total of 15 air permits currently issued for the planning unit, only monitoring data for several parameters of the B.C. Forest Products Kraft pulp mill indicate consistent non-compliance during the past three years. Continuing problems involve higher particulate releases than permitted, but past non-compliances in bivalent sulphur and discharge rate appear to have been resolved. Although prevailing winds generally do not result in pulp mill air emissions moving over Mackenzie, dispersal capability analysis concluded that the natural capacity for dispersal of airborne pollutants is lower in the Mackenzie area than in Prince George. Expansion of the forest industry in the Mackenzie area currently appears unlikely for at least the

next 5-10 years. Should expansions occur in the future, a thorough assessment of potential air quality impacts should be undertaken.

Slash burning activities everywhere in the planning unit, as in the rest of the Province, are not under permit. Other than in relation to smoke generated during waste wood clean-up in Mackenzie, the only other occasional degraded air quality occurs in the Bear Lake area, where wood waste burners exist near residential areas. Increased permit compliance could improve this situation, although not eliminate the problem. Woodwaste burners, due to their lack of design sophistication, cannot maintain satisfactory emission quality while the sawmill is cycling through production rate changes, species changes, startups, and shutdowns.

Future impacts of human activities on air quality have the highest potential in relation to coal mining, both in the Carbon Creek area, and along the rail right-of-way from North East Coal operations. A fugitive dust measurement program is now underway to monitor this potential problem.

6.3 MANAGEMENT OBJECTIVES

Until a major air emissions permit in the Mackenzie area might be applied for in future, at which time a thorough assessment of dispersal potential in that airshed would be required, the only present objectives for the planning unit are to bring all current permits under compliance. The most important of these is the BCFP pulp mill permit.

The basic long-range objective is to establish air quality criteria for B.C., eventually followed by specific objectives for different airsheds in this and other planning units to ensure that the receiving atmospheric environment is maintained at or above a quality that protects human health, animals and plant life. These criteria and objectives may vary from the presently published pollution control objectives. At present, specific ambient air quality objectives have not been established for any airshed in the Finlay-Omineca planning unit. When such objectives are established,

ambient air quality may be monitored, and waste discharge permits amended as necessary to ensure satisfactory ambient air quality.

6.4 MANAGEMENT OPTIONS

Since the only present air quality concerns involve bringing several permits under compliance, the only management options pertain to whether staff resources should be allocated to these permits or not, and how best to resolve existing non-compliance. Without such allocation of resources, it is unlikely air quality in the Mackenzie and Bear Lake areas will improve.

6.5 MANAGEMENT PLAN

Very little regional staff time relating to air quality is required at present in the Finlay-Omineca planning unit. However, sufficient staff resources will be allocated to resolve the permit non-compliance situations in Mackenzie and Bear Lake. For the next 5 years, no significant changes are likely to occur in this pattern, with staff time essentially being limited to permit compliance activities. It appears unlikely that any additional monitoring will be required in the Mackenzie area, unless an unexpected degradation of air quality occurs there. Some staff resources will be required to aid in the fugitive coal dust study which has been undertaken along the railway lines.

APPENDIX 1

WILLISTON RESERVOIR COMPENSATION: WILDLIFE MANAGEMENT ACTIVITIES

Williston Lake Wildlife Compensation Plan

B. C. Hydro and Power Authority

and

Ministry of Environment,

Northern Interior Region

January, 1989

1. Introduction

The creation of the Williston Reservoir in 1968 significantly impacted wildlife populations in the Reservoir area. The two most detrimental effects of the impoundment have been the permanent loss of highly productive habitat and the consequent displacement of many species to less productive lands. The flooding of the bottom lands of the Parsnip, Finlay, and Peace Rivers inundated approximately 1400 sq. km. of Class 1, 2, and 3 moose winter range. A 1982 Ministry report titled 'A Resource Management Strategy for the Williston Basin' noted that moose populations were severely impacted by the impoundment. Although some studies of the reservoir and environs were undertaken by the Ministry of Environment and B. C. Hydro in the 1970's, the full extent of the impacts has never been identified. Under clauses 'n' and 'o' of the Water Licence granted to B. C. Hydro for the W. A. C. Bennett Dam, the Crown Corporation was required to identify, undertake, and complete remedial measures for a number of impacts, including those on wildlife resources. The 1975 Bonar Report (funded jointly by B. C. Hydro and the Ministry) identified some of the impacts of the Williston Reservoir. This report provided only an overview of the use of wildlife (hunting, trapping, and guiding) in the Reservoir area, rather than a detailed inventory of wildlife populations and habitat. Despite its limitations, the 1975 Bonar Report remains the most comprehensive documentation available of the state of wildlife resources in the Williston Lake area.

Subsequent to the creation of the Williston Reservoir, forest resources in the area have been extensively developed in the western portion of the Reservoir drainage area. Forest harvesting has had mixed effects on wildlife; for example, improved access has provided hunters with more recreational opportunities while placing greater stress on already reduced wildlife populations; alteration of habitat may have benefited some species such as moose, while adversely affecting others such as caribou and grizzly bear. As a whole, however, wildlife populations in the Williston Reservoir area have declined as a result of habitat loss, alienation, and access developments. This agreement for compensation by B. C. Hydro, therefore, is timely in view of the growing pressure on a declining resource. This document sets out the management measures which will partially remedy the impacts on wildlife resources which resulted from the impoundment.

2. Goals and Objectives

The broad goals of the proposed program are to: assess wildlife habitat and populations; identify areas which are suitable for enhancement or protection, and undertake appropriate enhancement measures. The specific objectives of the program are:

1. To determine the present and potential distribution, abundance, and population structure of major wildlife species (ungulates, bear, waterfowl, and furbearers) and ecotypes in the Reservoir area. This will require the following:

(a) the identification of present population status and past trends of the major species, their habitat requirements, and the location and characteristics of important habitats;

(b) the identification of population and habitat factors currently limiting wildlife production, and an assessment of whether they are amenable to change;

(c) the possible preservation of enhancement opportunities for some critical wildlife habitats, either through statutory designation, interagency agreement, or title transfer (purchase) to the Ministry of Environment.

ii. To develop a set of working plans for each year of the management period which will give budget projections by activity for the management programs.

iii. To design and implement monitoring and assessment programs to determine whether management objectives are being met.

3. Compensation Program

To achieve the above objectives, the compensation funds are to be directed to a two-phase program. Phase I of the program has three components:

(1) a biophysical mapping program;
(2) baseline inventory studies;
(3) the acquisition (purchase) of some critical habitat which is currently deeded land.

Phase II of the proposed program has one component, consisting of activities which will enhance wildlife habitat.

The mapping program and baseline inventory studies will provide broad management direction, however, the emphasis will be to initiate activities which will benefit wildlife in both the short and long terms. It is the Ministry's view that, given the state of wildlife resources in the Williston Lake area, immediate remedial measures are required. Some enhancement activities will commence in Year 1 of the Agreement between B.C. Hydro and the Ministry. It is important to note, however, that the nature, extent, and location of many enhancement activities will be largely contingent upon the results of the mapping and inventory programs.

3.1 Biophysical Mapping Program

The primary emphasis of the biophysical mapping program is to identify and assess areas of high capability for ungulates. The mapping will be done at a scale of 1:250,000 for the Finlay and Parsnip Reaches, and will take three years to complete. The relevant Management Units (M.U.'s) to be mapped include:

North 7-16, North 7-24, 7-29, 7-30, 7-37, East 7-38, South 7-40, and South 7-41.

Some areas of high capability and use may be mapped at a larger scale (1:20,000) if required. The products of the program will include:

(1) an ecological (biophysical) habitat map interpretable for several species and themes;

(2) maps showing present vegetative cover;

(3) maps identifying ungulate and bear capability;

(4) maps identifying ungulate and bear suitability;

(5) a report summarizing the results and recommending habitat management activities.

The mapping program is essential to identify suitable areas for habitat enhancement. Further, it will identify critical habitat which may be considered for protection from development.

A capability mapping program is not proposed for the Peace Reach of the Reservoir. In 1984, the Ministry initiated a mapping program for some areas of the Peace Reach. This mapping is being done at a scale of 1:50,000 and will be completed in 1989. This program is not considered part of the compensation agreement with B.C. Hydro.

3.2 Baseline Inventory Studies

An animal census program will be undertaken to inventory wildlife populations in the Finlay and Parsnip Reaches of the Reservoir. The emphasis of the program will be to inventory populations in key management areas of these two reaches. A census program for the Peace Reach is not proposed. The Ministry recognizes that a complete census of the Parsnip and Finlay Reaches would involve a significant cost, consequently it proposes that the census be based on areal stratification with sub-sampling of representative habitat types for extrapolation. The stratification will be based on biophysical mapping combined with forest cover maps. Method development would be undertaken prior to the actual census.

The census program will require approximately three years to complete and will concentrate on the following species: moose, caribou, elk, sheep, goat, grizzly bear, and wolves. An inventory of the following species is considered a lesser priority: mule deer, black bear, furbearers, and waterfowl.

The product of the inventory program will be a report relating the basic population data (numbers by species, age, sex, distribution) of the priority wildlife species adjacent to the Finlay and Parsnip Reaches.

3.3 Habitat Acquisition

There are some parcels of deeded land in the Reservoir area which have significant potential for enhancement to benefit elk and deer. The acquisition of these properties is desirable if it can be accomplished at a reasonable cost.

3.4 Wildlife Enhancement and Monitoring

This component of the compensation program will require the largest allocation of funds, and will continue indefinitely. Many enhancement opportunities in areas adjacent to the Lake will be identified from the mapping and inventory work proposed for the Finlay and Parsnip Reaches and currently underway in the Peace Reach. For some areas, enhancement can commence without prior mapping and inventory work. With the approval of the Ministry of Forests and the Ministry of Crown Lands, a variety of enhancement measures may be utilized, including, for example:

(a) prescribed burning of non-merchantable timber and grasslands;

(b) mechanical thinning;

(c) forest harvesting prescriptions to create habitat mosaics;

(d) herbicide treatments; and

(e) re-introduction or transplant of some species.

Habitat enhancement activities in the Finlay and Parsnip Reaches will largely concentrate on Class 2w and 3w lands. Virtually all of the class 1w land is believed to have been inundated by the Reservoir. It is expected that enhancement activities in these areas will be more costly (on a per hectare basis) than those in the Peace Reach. Enhancement in the Peace Reach will involve burning of shrub grasslands, while in the Finlay and Parsnip Reaches, a variety of more costly enhancement methods will be employed. In addition, potential enhancement sites in these two reaches are more widely dispersed and access is generally more difficult. Many enhancement activities will require the contracting of labour and equipment.

3.4.1 Peace Reach Enhancement Program

Enhancement activities in the Peace Reach will be undertaken on Crown land and those lands acquired under the previously-identified acquisition program. The primary species targeted for enhancement in the Peace Reach are elk and sheep, although moose and deer will also benefit. The program will involve burning approximately 2500 ha./yr. for a period of 5 - 10 years. When the burning cycle is complete, a maintenance program will continue. The increased carrying capacity which results will be sufficient for an additional 600 - 800 elk and 200 - 250 sheep.

The enhancement activity will concentrate in the northeast portion of the Peace Reach, in the vicinity of Dunlevy, Aylard, and Schooler Creeks. In 1985, the Ministry transplanted 147 elk in the Carbon Creek and Dunlevy Creek areas. Today, largely due to a winter range burning program, the population of these two herds is over 200 animals. Additional funding will permit an expansion of this enhancement program and allow for consumptive use in the future.

3.4.2 Finlay Reach and Parsnip Reach Enhancement Programs

The enhancement program will benefit a variety of species in the Finlay and Parsnip Reaches, although it will be directed towards ungulates. Approximately 10,000 hectares of ungulate habitat will be enhanced annually (subject to results of the mapping program). While the mapping and inventory programs will determine the high priority sites for enhancement in the two Reaches, the following indicates which species and locations may be considered:

Moose - this will be the priority species for enhancement. Areas adjacent to the Reservoir which are believed to offer enhancement potential include: the Lower Parsnip River area; the burn along the Nation River; Blackwater Creek and Blackwater Swamp; Lower Manson River; Elklund Creek Swamp; Fries Creek, and Stanbury Creek burns. It is believed that current moose populations can be increased by 20-25% in the first five years of the program.

Thinhorn Sheep & Mountain Goats - enhancement of winter range on the Russell Ranges may increase the estimated current population of 500 animals by 30%. It is believed that range enhancement and possibly a transplant may be viable in the Mount Selwyn and Mount Crysdale areas. Winter range in the Mount Henri area may also be a candidate for enhancement.

Caribou - techniques for enhancement of winter range are not well developed at present. The Jackfish Creek area (west of the Wolverine Range, south of the Omineca River) is believed to contain important habitat with some enhancement potential. If enhancement methods are not viable, it is probable that the Ministry will continue to attempt the protection of winter range.

Grizzly Bear and Black Bear - both may indirectly benefit from ungulate enhancement programs. Enhancement of bear habitat is likely to be impractical, and high use/capability areas may be considered for protection.

Elk - small populations are known to exist along the Reservoir. Enhanceable habitat is believed to include: Bevel Mountain; Mount Moodie; the Wolverine Range; and areas near the Ospika, Omineca, Akie, Ingenika, and Nation Rivers.

Furbearers - it is probable that enhancement measures for furbearers are not viable in this area. A waterfowl enhancement project in the Blackwater Swamp, which is being undertaken by Ducks Unlimited, will benefit some aquatic furbearers.

There are three general categories of lands in the Finlay and Parsnip Reaches to which enhancement activities could be directed:

I. These are areas which, subsequent to a brief assessment, could be enhanced in Year 1 of the Agreement between B.C. Hydro and the Ministry. Detailed mapping and inventory is not required for sites in this category. Included in this category are:

   (a) Blackwater Swamp - within its 44,000 ha., there are sites which could be enhanced to benefit moose, furbearers, and bear.

   (b) Raspberry Swamp - enhancement of the willow complexes within the swamp's 16,000 ha. would benefit moose.

   (c) Lignite Creek - a 5,000 ha. area comprised largely of willow complexes; enhancement to benefit moose.

   (d) Tobin Lake - some of the 1,500 ha. of swamp and side hill in this area could be enhanced for moose and bear.

   (e) Ospika Arm Burn - moose enhancement.

   (f) Phillips Creek - moose enhancement.

   (g) Russell Ranges - sheep, goats, moose, and bear.

II These are areas which require a site inventory to determine habitat use by ungulates prior to enhancement:

   (a) Lower Pack R., lower Parsnip R., floodplain - moose, furbearers, waterfowl.

   (b) Lower Nation R. - moose, grizzly bear, possible elk transplant.

   (c) Selwyn Mountain - sheep and goats.

   (d) Lower Ingenika River - moose, elk.

   (e) Wolverine Range - elk, moose.

   (f) Omineca River - moose.

   (g) Jackfish Creek - caribou.

   (h) Finlay River - moose, furbearers.

III. These are areas which are believed to be suitable for enhancement, but which require more detailed assessment and mapping (1:50,000 scale) prior to undertaking enhancement work.

These areas would be identified from the 1:250,000 scale mapping program.

3.4.3 Monitoring

An important component of the enhancement program will be the assessment of the program's effectiveness. This monitoring will enable the Ministry to modify, discontinue, or expand activities depending on their effectiveness. Monitoring will consider, for example, vegetative response to treatment and animal utilization. Detailed methodologies for the evaluation will be developed. Annual progress reports will be prepared and submitted to B.C. Hydro and the Ministry of Environment.

APPENDIX 2

WILLISTON RESERVOIR COMPENSATION: FISHERIES MANAGEMENT ACTIVITIES

Williston Lake Fisheries Compensation Plan
Phase I: 1988-1991

A Joint Program Undertaken by

B. C. Ministry of Environment

Northern Interior Region

and

B. C. Hydro & Power Authority

January, 1989

(1) STUDY BACKGROUND

Williston Lake is the largest body of fresh water in British Columbia. It was formed in 1968 by completion of B. C. Hydro's W.A.C. Bennett Dam on the Peace River, 26 km upstream of Hudson Hope. The dam, 183 m high, has a crest length of 2134 m. The reservoir has a surface area of 1736 sq. km and a shoreline perimeter of 1770 km. Full storage level (672 m) was reached in 1972. Annual drawdown from 1972-1987 has averaged 16.8 m with a low surface elevation of 655 m normally occurring in early spring. In 1987, B. C. Hydro proposed increasing the annual drawdown to the full extent of its water licence, namely an annual drawdown of 32 m with a minimum surface elevation of 640 m.

Three rivers were impounded to create Williston Lake - Peace, Finlay, and Parsnip. Each has remained relatively discrete, existing now as reaches: the Finlay and Parsnip Reaches lying in a north-south direction in the Rocky Mountain Trench, and the Peace Reach lying in an east-west direction over the former Peace River Valley.

A number of fisheries and water quality investigations have been conducted on Williston Lake and its tributaries. A preliminary overview of the fisheries resource and potential of the lake and tributaries was conducted in 1975 by the Fish and Wildlife Branch and B. C. Hydro as partial fulfillment of Clause 'o' in the original water licence issued to B. C. Hydro. This program documented species presence and certain life history parameters, limnology, and tributary stream assessment. However, owing to the early age and characteristics of the reservoir, and the limited duration of the study, most of the data collected are too general and may no longer be applicable in the formation of any management strategies. Due to its proximity to major population centres, i.e. Prince George, Mackenzie, Fort St. John, Dawson Creek, and Chetwynd, Williston Lake is a potential major recreational waterbody. It is particularly important in the Peace River area because there are few accessible lakes. Angling is one of the most important recreational activities on the lake. In the past, fishing pressure has been light relative to the size of the reservoir, due primarily to limited access and debris problems, particularly near tributary creek mouths.

During the last five years, there have been increasing reports from anglers about the decline of the Williston Lake fishery as reflected in reduced catch rates compared to the 1970's. The rainbow trout fishery has declined significantly, with a fishery essentially restricted to the lower Peace Reach and a few tributary streams and embayments. Dolly Varden appear to be maintaining their relative numbers, although large fish are not standing up to the intensive pressure generated at tributary creek mouths. Arctic grayling have virtually disappeared from the lake as a sport fish, with remnant populations persisting in large tributary systems such as the Parsnip and Finlay Rivers. Kokanee populations have been steadily increasing, with reports of fall spawning runs developing on a number of

tributaries, and increasing numbers of fish being caught by anglers. The status of lake whitefish and assorted coarse fish populations is presently unknown. There has also been renewed interest in the commercial fishing potential of Williston Lake for whitefish. The Provincial Recreational Fisheries Branch has been incapable of effectively responding to either the sport fish or commercial fisheries issue. This is due to an almost total lack of current fisheries information on stock strength and other life history parameters. Because of the absence of this essential information, it has not been possible to develop and initiate a management program for the Williston Lake watershed other than by applying restrictive regulations.

(2) GOALS AND OBJECTIVES

The goals of the proposed assessment program are to evaluate the status and character of different sportfish populations (including whitefish) and to identify possible enhancement opportunities. Specific objectives of this proposed three-year study are to:

a. Ascertain relative abundance of different fish species.

b. Determine the contribution of different sportfish species to the recreational fishery.

c. Describe life history characteristics of sportfish populations, i.e. age structure, growth, sexual maturation, survival, reproductive success, temporal and spatial movement patterns, health, and diet.

d. Determine angler effort, catch and harvest on Williston lake and tributaries.

e. Examine lake whitefish populations to determine the feasibility of a commercial fishery for this species consistent with Provincial Recreational Fisheries Branch policy.

f. Examine tributary streams and evaluate them as to their suitability for sportfish enhancement. Specific streams will be assessed following initial reconnaissance in Year 1, followed by detailed evaluation in Years 2 and 3.

The program will involve two phases: Phase I work involves an assessment of the fishery resource, an angler creel survey, a limnological study, and an assessment of enhancement potential; Phase II will involve undertaking the appropriate enhancement activities identified in Phase I.

(3) WORK PROGRAM

a. Field Activity

Field activities will focus on four major sub-programs:

1 Fishery Resource:

Assessment of sportfish populations, specifically standing crop, species composition, and relative levels of abundance, in all three reaches of Williston Lake, will be accomplished by gill-netting, seining, trapping, angling, electroshocking, and hydroacoustics. Lengths, weights, scale samples, and in the case of char, otoliths, and any identifying marks, e.g. tags, will be recorded for all sportfish. A sub-sample of all fish species will be sacrificed to ascertain diet, sex, maturity, presence of parasites, and concentration of mercury in tissue. As many fish as possible, especially sportfish, will be marked with Floy anchor tags, to gain an insight into movement patterns, growth of individual fish stocks, distribution, and harvest in the recreational fishery.

The fishery assessment will continue through Years 1 and 2, with analysis of results determining possible continuation into Year 3.

2 Angler Creel Survey:

Creel surveys will be conducted at selected locations on all reaches of Williston Lake. There will be two crews, one to survey anglers on the Peace Reach during the summer and winter seasons, and one on the Peace Reach near Mackenzie to cover the summer fishery. Information will be collected on number of anglers, angler effort, angler origin, catch and harvest. Relevant biological information will be collected from landed fish. In addition, aerial fixed-wing survey counts will be co-ordinated with ground surveys in all reaches to provide information on angler distribution. The creel survey will initially be scheduled for Year 1, with a possible extension into the second year, dependent upon review of the data collected. The creel survey results will be used as a baseline against which the results of anticipated enhancement programs may be measured.

3 Limnology:

A comprehensive one-year limnological study, designed to permit comparability to earlier B.C. Research and B.C. Hydro studies, will be completed in the first year of the program.

4 Enhancement Potential:

Tributary assessment and identification of enhancement opportunities will be conducted throughout the duration of the three-year study. Assessments and inspections will be done by ground walks, snorkel swims, and helicopter/fixed-wing reconnaissance flights. It is anticipated these assessments will lead directly to the development of specific enhancement programs which will be implemented in Phase II. It is recognized that areas of enhancement other than tributaries (including areas outside the reservoir) may also be evaluated. The latter would only take place in the absence of any identifiable opportunities within the reservoir or to tributaries flowing directly into the reservoir.

b. Laboratory and Data Analyses

1 Fisheries Resource:

Analysis of data for all sportfish species will allow conclusions to be drawn on the distribution and relative abundance of different age classes, mortality rates, and other relevant life history characteristics of sportfish populations; condition factors of all species; the biological viability of a commercial fishery for whitefish; overall status of Williston Lake sportfish populations.

2 Creel Survey:

All creel survey data will be extrapolated to ascertain which stocks contribute to the recreational fishery and to estimate effort, catch and harvest. Biological data will be examined to determine age structure of catch, condition, age at sexual maturity, etc. Where possible, this information will be complementary to the fisheries resource data.

3 Limnology:

All limnological samples will be analyzed as outlined in the B.C. Hydro Limnological Program, consistent with previous studies, such that direct comparability of changing reservoir conditions can be made.

4. PROJECT MANAGEMENT SCHEDULING

The assessment program is consistent with a high level of management as identified by the B. C. Recreational Fisheries Branch Large Lake Management Committee. The program will be carried out by the Ministry of Environment and B. C. Hydro staff.

The fisheries field work will commence immediately after ice out (mid-May) and extend into early November (first ice on tributaries).

The creel survey will be carried out by the Ministry of Environment at the W. A. C. Bennett Dam and the Parsnip Reach from mid-May to mid-September, and at the W. A. C. Bennett Dam from January to the end of March.

Limnology, water quality, and determination of mercury in fish tissue and sediment will be carried out by B. C. Hydro, as will hydroacoustic studies.